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CHEMICAL & METALLURGICAL ENGINEERING

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For Simplified Practice in Expositions

BY COMMON CONSENT the Tenth Exposition of Chemical Industries was the best of its kind ever held. Exhibitors and visitors alike gave their approval to the new plans and policies. Exhibitors were pleased with the service rendered by the management as well as with tangible results in the form of sales and prospective business. Over 12,000 visitors with a direct interest in the exhibits registered during the week and found it possible to discuss their problems with manufacturers free from interference by the sight-seeing public. Admission of the latter was restricted to the evenings to the satisfaction of all. A spirit of harmony and optimism prevailed. Discontent and dissatisfaction were notably absent. Altogether it was such a show as one could ill afford to miss either as exhibitor or visitor.

LIGHT IS BREAKING on the chemical exposition question and there is reason to hope that before long the confusion and dissension of the past few years will be dispelled. The greatest single step in clarifying the situation was the announcement of the management of the New York exposition that, in response to the preference of exhibitors, shows would be held biennially hereafter and would otherwise conform to exhibitors' wishes as to conduct and character. At the exposition just closed, the management frankly adopted some of the successful features of the Providence exposition of the Chemical Equipment Association, which contributed in no small degree to the general satisfaction with the New York show. Thus competition was not without its benefits and the Association is entitled to credit for its accomplishments.

BUT THE INDUSTRY is still confronted with two expositions. More than that, expositions have been more frequent than ever before with little prospect of immediate relief. According to present plans we shall have had three expositions within eleven months, from Providence in June, 1925, to Cleveland in May, 1926. And many believe that biennially is often enough! This takes no account of the Sesqui-Centennial at Philadelphia in 1926, at which some equipment manufacturers will want to be represented. Following that will come the regular New York exposition in 1927. The Chemical Equipment Association has formally committed itself to an exposition in 1928, so that the prospect of shows already in sight is sufficiently appalling to many to call a plague on all their houses.

NO GOOD PURPOSE would be served by reviewing or criticizing the events that have led up to the present situation. It is evident in retrospect that, however disturbing they may have been at the time, the net result has been beneficial. We are now concerned with the future. In our judgment the success of the Tenth Exposition of Chemical Industries points the path to be followed. Exhibitors there have frankly stated that two shows are not necessary. The management has given ample assurance and evidence of a desire to meet exhibitors' wishes. It is in the exposition business and can draw upon a vast fund of experience. Isn't it logical to take advantage of the established machinery of such an organization and reserve our own time and efforts for the promotion of chemical engineering in this country?

THE Chemical Equipment Association was not organized for exposition purposes. No one is aware of this more than the members themselves who now realize that the Association has reached a point in its career where it can and should take up its functions as a trade association. If it once felt called upon to depart from its declared aims, it can now resume them with a feeling of success and satisfaction in the results of its venture. In the light of the recent New York success, and particularly in view of the fact that a number of equipment manufacturers are already thinking of the Sesqui-Centennial at Philadelphia, the advisability of giving up the Cleveland show has been suggested. In that event the future will take care of itself, and in the meantime exhibitors will not feel the burden of too many expositions.

Ups and Downs of an Intrepid Inventor

LOUIS ENRICHT and his famous process for extracting gasoline and methanol from peat, as well as money from the pockets of investors, first came to our attention almost five years ago. In fact, it was in our issue of February 2, 1921, that we described a dramatic demonstration of one of Enricht's inventions that clearly antedated synthetic methanol and promised shortly to put Standard Oil out of business. The yields of 120 to 125 gal. of navy "gas" and 20 to 25 gal. of pure methanol were obtained from a ton of ordinary peat by means of a highly complicated apparatus containing among other things an automobile tire pump connected to catalytic converters for gasoline and alcohol. We recall the pump in particular because a few months later it figured prominently in a less successful demonstration in a Long Island courtroom. Over Enricht's protest but at the insistence of a well-known chemical engineer in the opposing counsel, the pump was taken apart and found to contain the gasoline that was later to appear as the final product of the complicated process.

Then Enricht went to Sing Sing for an extended stay and, we had hoped, to learn a lesson about the dangers of dabbling in chemical quackery. In any event we had almost forgotten about him until a few months ago we happened to see a short news item in an Albany paper to the effect that executive clemency had been asked and granted the aged inventor—he is in his 81st year—because his precarious health, it was claimed, was being affected by the oppression of prison confinement.

Apparently, though, the Albany paper was misinformed about the reasons for Enricht's release, or at least quite a different story was told the Long Island correspondent of the Brooklyn *Eagle*, whose account of his interview with the octogenarian was lately given prominent space in that publication. It seems that on his arrival at Sing Sing, Enricht was immediately placed in charge of the chemical laboratory and after painstaking research discovered a wonderful serum that neutralizes the effect of morphine on the human system. This great service to humanity was immediately heralded to Albany with the result, according to the *Eagle's* correspondent, that "Enricht's commutation of sentence by Governor Smith came within 30 days after making this discovery."

Now the valiant inventor, undaunted by his jail term, returns to Long Island and prepares again to market his famous "green gas" which is another of his scientific achievements. This is a gasoline substitute invented during the stress of war but never developed, we are told, because the War Department, anxious to utilize it in the national defense, placed a 6-year injunction enjoining Enricht from either manufacturing the gas or imparting its formula to outside interests. "Green Gas," according to the newspaper interview, "is nothing more than a liquid compounded with nitro-glycerine and water to which is added an ingredient that makes the glycerine soluble in water. This permits it to be carried into the cylinder of the engine where the explosion occurs." Since it can be manufactured for 4 cents per gallon, and since all legal restrictions have now been lifted, Enricht is certain that his product is going to meet with immediate commercial success. Without wishing to appear unduly pessimistic, however, we would call the inventor's attention to the fact that anti-knocks are now the order of the day in the gasoline business. The newspapers are full of schemes for preventing detonation and otherwise taking the high explosive qualities out of the operations of the internal combustion engine.

Still, judging from the number of these projects seeking financial support, the field must be fertile especially for the expert cultivator. And surely Enricht is no amateur. Since he first came from Germany in Civil War days his picturesque career has included such diversified occupations as reclaiming the sand dunes of the Pacific and prospecting for gold in Mexico. Tiring of strenuous duties as Sheriff of Cochise County, Arizona, he came East to develop a process for making artificial marble. Imitation metal statuary next had his attention, then gasoline from peat, the antimorphine serum, and now green gas. To be sure none of these have ever been marketed but the inventor is not easily discouraged. There is something almost admirable about the old fellow's persistence and we hope that in steering the future course of his already eventful career, he can avoid the rocks of legal obstruction and the straits of prison confinement.

Technical Progress in the Pulp-Paper Trade

AN ARTICLE on another page of this issue indicates the scope that exists for the introduction of efficient and economical methods in what might well be termed a modern paper-making plant. But attention should be drawn to the fact that the organizing of such work is so complex and the effects in the plant are so far reaching that in most instances the planning and reconstruction are beyond the power of plant executives. Such reorganization is clearly a task for expert engineering talent, undivided responsibility and uninterrupted attention.

In prominent relief stands the significant economies that have been effected in power-plant production and the closer co-ordination of power and heat requirements. A significant reduction in labor costs, the close control of fire hazard and the avoidance of spoilage have been secured by a comprehensive scheme of mechanical handling and storage of the raw products. The use of continuous beaters is an innovation that has automatically solved the problem of unsorted waste, whereby the expense of removing foreign matter or the alternative, damage to equipment, is avoided. By the adoption of the Trimbey system of automatic control in proportioning and mixing the various ingredients that form the "furnish," power is saved and uniformity of result is secured. The use of the K-B process for waterproofing paper with asphalt is an innovation that has broadened the field of application of the ultimate product.

The pulp-paper industries have been somewhat tardy in recognizing the growing need for economy and efficiency in the operation of their plants, and the advantages to be gained by reorganization along comprehensive engineering and technical lines. The article in question can be read with profit by the majority of executives and operators.

Avoid a Compromise of Engineering and Politics

ON MANY occasions in the past Muscle Shoals has been a bone of contention between politician and engineer. That the end is not yet in sight is clearly indicated by two recent pronouncements that should have the attention of all who are sincerely interested in the government's efforts to find a solution for the problems of Muscle Shoals.

One of these views is that of the distinguished chairman of the Advisory Commission appointed last March by President Coolidge. The other comes from the head of a great manufacturing concern and carries with it the endorsement of the entire fertilizer industry. To draw the deadly parallel between the recorded statements of these two men is manifestly unfair for they were prompted by different circumstances and from what might be regarded as opposing viewpoints. Yet unfortunately it is all too clear, we believe, that the view which should express the impartial and mature judgment of the government's investigator contains nothing but the false economics and empty phrases of the professional politician. On the other hand, in the statement in which we might, perhaps, expect to find partisanship and self-interest, there is the dominating quality of leadership that comes from the carefully weighed conclusions of an engineer's analysis.

Just before the Muscle Shoals Commission went into continuous, and we regret to say, secret session, Chairman McKenzie delivered a most unusual statement which is indeed unfortunate if it represents the philosophy with which the Commission is attacking the problem before it. It begins with the politician's usual confusion of the issue: "Neither the welfare of agriculture nor the best interests of National Defense will be served by permitting our great nitrate plants to remain idle" is the Chairman's firm conviction. Government operation, he maintains, will assure the people of this country "and especially the farmers" that these plants as well as the power from Wilson dam will be used for the purpose for which they were intended by the great and all-wise Congress. He pictures the valleys of the Tennessee and Clinch Rivers embraced in a gigantic government-operated system carrying cheap power to every hamlet from the Mississippi to the Carolinas—cheap because government 3-per cent money will carry on the development and operate the lines. But the Chairman would not limit government competition with industry to the power companies:

> "Take carbide, for instance; it sells for $400 per ton but there is nothing in it but limestone and coke and power. We can get all of these very economically—we have our own cheap power and our own high-grade limestone and we can get splendid coking coal right on the Tennessee River. We wouldn't have to charge $400 a ton for our carbide to make money."

Somebody has been giving away trade secrets to the Commission. Other of our chemical industries had better be careful! "Our postal system," continues the chairman, "is the admiration of the world, and our arsenals are very efficient manufacturing plants run on the Taylor-time-study system. There are no politics in either of them and the same methods they use will keep politics out of our power and fertilizer operations."

It is a decided relief to turn to the sane discussion of "The Problems of Muscle Shoals" by Charles H. MacDowell, which the National Fertilizer Association presents to the Muscle Shoals Inquiry as representing the industry's views on this great project. That we cannot subscribe to all of the detail of Mr. MacDowell's conclusions does not detract from the opinion that he has given us a masterful report. At the outset he re-emphasizes the cleavage to which we have so often called attention, namely, the two distinct problems at Muscle Shoals which must not be confused—the disposal of the nitrogen fixation plants and the most effective use of the power to be developed there. That MacDowell would have the government retain plant No. 1 as a large-scale experimental station for the Army and Navy is not likely to meet with the unqualified approval of those in industry who believe that even in research private initiative may be expected to make the greater progress. Whether or not plant No. 2 is to be salvaged, to be held in stand-by condition for a few years as preparedness for a war-time emergency, or to be leased for private operation is a problem that can be viewed quite apart from the question of power. It is for this reason that MacDowell attempts to disillusion the public in its erroneous, but long held, impression that cheap electric power is essential in nitrogen fixation.

The primary power from Wilson Dam must be disposed in such a way as to give the greatest service to the public, and should, Mr. MacDowell believes, be sold to municipalities or public utilities. The great bulk of the secondary power, except that to be used for experimental purposes at plant No. 1, should be available at reasonable cost for electrochemical and metallurgical developments by private industries. To most of this plan we would lend our hearty support, yet it should be made clear, we believe, that the power problem at Muscle Shoals must be considered only with the plans in mind for the development of the entire Tennessee River project along the lines of the survey by Major Fiske. In other words, what is done at Muscle Shoals should not jeopardize the future of the much greater development either by intimidating or holding out false promise to private interests. And in this connection, we believe that any arrangement for the sale of power to any particular industry at less than the rate of interest for this same power from public utilities or other industries is a virtual subsidy. Whether it is for fertilizer, carbide, or aluminum, the government, cannot justify the policy of subsidies to industry.

Perhaps the most commendable feature of the MacDowell report is the analysis of Muscle Shoals as a possible center for fertilizer production. That it has no inherent advantages, in fact is at a disadvantage, for the manufacture and distribution of even the highest grades of mixed fertilizers is clearly shown by a comprehensive study of raw materials costs and the out freights on the finished products.

October promises to be a busy month for the Commission and in spite of the fact that its important deliberations are to be conducted in secret, the outcome will be anxiously awaited. It is to be hoped that the pronouncement of the chairman is not to be regarded as prophetic of the Commission's final recommendations. Rather, there must be a thorough sifting of facts with a fearless presentation of the conclusions of an impartial analysis. The responsibility that rests with the Commission is great and it will not be faithfully discharged if engineering principles and sound economics are compromised with political expediency.

Precise Measurements in Cost Accounting

BACK in school days we had a professor who was subject to a slide-rule complex. One day as he was applying the usual "slipstick calisthenics" to an equation on the blackboard, his students quickly discovered that the expression, upon inspection, was reducible to 4. But the engrossed professor failed to heed these premature estimates, and finally announced: "Gentlemen, the coefficient is 3.999"!

Such a delightful bit of leaven in the lump of senior engineering has so impressed us with the principles underlying the precision of measurements that we are forever looking for good examples of bad practice. Cost accounting as inflicted on many plants is an illustration to the point. The final cost figures, when arrayed with a respectable series of digits to the right of the decimal point, may seem innocent enough; but too often they are sources of real financial danger. W. L. Churchill, in *Management and Administration* for August, shows that errors in costing a product often total 10 to 15 per cent, or sufficient to reduce a supposedly substantial factory profit to zero.

Mathematical accuracy and elaborate paper systems mean nothing until adequate means of measuring raw materials, labor, power and the component overhead charges have been devised and applied intelligently in each plant. Factory cost accounting sorely needs, as a foundation, the principles of precision and measurement.

Budget Standards in Cost Accounting

THE justification of cost accounting lies in its worth as a guide to efficient management and increased profits. Recognizing this fact, forward-looking plant executives in the chemical engineering industries are leaning towards budget standards as a basis for such work.

The budget system, as its name implies, differs fundamentally from the conventional historic system in that definite standards are set for each charge to production expense. Setting of standards is accomplished by a critical analysis of past cost data, the result being a series of tentative standards that subsequently must be modified until experience shows that the optimum has been attained. It is then possible accurately to correct these standards to any other conditions by applying the proper index numbers.

The foregoing method of setting standards presupposes an adequate mechanism for cost finding; and therein lies the inherent soundness of the budget system. The necessity of thorough cost research involving each unit operation or production center undoubtedly is valuable in itself. But the principal benefit to be derived from this system is the effective control of costs *while the work is in process.* Current trends can be interpreted, responsibility can be definitely fixed and knowledge of the fact that costs are an open book provides an incentive for employees that makes for maximum economy.

In the historic system on the other hand, no standards are provided. Everything is relative. The managerial tendency is to interpret costs entirely on the basis of past reports, and even on similar statements from another company. Furthermore, junior executives and clerks are tempted strongly to "doctor" such reports to conform to previously accepted levels. Serious discrepancies in costs may thus escape detection until it is too late either to find the trouble and apply a remedy, or administer disciplinary measures with telling effect.

The wide and successful application of budgets in the marketing and financial functions of industry suggests a similar opportunity in production, and it is believed that chemical plant executives in their continual efforts to attain greater operating efficiency, should abandon gradually the insensitive historic system and adopt the more rational system of budget standards.

Electrochemistry, Muscle Shoals And Concentrated Fertilizer Materials

AT CHATTANOOGA last month the American Electrochemical Society offered a well-rounded symposium on the relation of electrochemistry to the production of fertilizer materials. Combined with a trip to Muscle Shoals, the program proved timely, attracted a good attendance and aroused animated discussion. Nitrogen fixation came in for considerable attention; and it developed that although the relation of electrochemistry to this industry may have waned with the decline of the arc process, electrolytic hydrogen for synthetic ammonia is not without strong proponents. The production of urea from cyanamide also sustained interest in an electrochemical process and product that have lately diminished in importance in the fertilizer industry. Finally, phosphoric acid and its compounds shared electrochemical attention.

In the course of the symposium the subject of concentrated fertilizer was brought into the foreground, and considerable attention was given to ammonium phosphate whose constituents—synthetic ammonia and phosphoric acid—are now being made in this country. Discussion developed the fact, however, that neither of these products is finding its way into fertilizer materials, nor are present manufacturers looking to fertilizers as an outlet in the near future. Synthetic ammonia is flowing first into the market for anhydrous for refrigeration and second into aqua ammonia for industrial chemical purposes. An indirect effect is to divert coke oven ammonia from these uses and force it into ammonium sulphate for fertilizer. Electric furnace phosphoric acid is finding its outlet in food products and miscellaneous chemical uses. Evidently economic and industrial conditions must change radically before any substantial quantity of these products will enter the fertilizer industry.

All of this, of course, has a direct bearing on the nitrate plants at Muscle Shoals to which the politicians love to refer as great fertilizer plants, and for the operation of which, either privately or governmentally, they loudly clamor. Others have long since ceased to think of Muscle Shoals as a great center for the manufacture of mixed fertilizer, if, indeed, they ever so regarded it. If it now bears any relation to the fertilizer industry it is to be found in the production, probably on a small scale, of concentrated fertilizer materials like urea and ammonium phosphate. It is not unlikely that some companies may wish to engage in such production there, and that others may wish

to experiment in a pioneer way with methods of nitrogen fixation. The products would doubtless find their way without difficulty into mixed fertilizer. Generally speaking, however, Muscle Shoals is not destined to become a great fertilizer manufacturing center in the near future, if at all.

Open Season for Hardened Copper

THAT hardy perennial, hardened copper, has cropped up in the press dispatches again, this time from Lorain, Ohio, where E. E. Harrison, negro labor foreman, "has perfected a process to make pure copper as hard as tool steel." The news report is defective in omitting the customary reference to rediscovering the lost art of the Mound Builders, or other ancient races, and no prediction is made that surgical instruments, razors and other edged tools will soon be made of pure hard copper. Otherwise the announcement runs true to form because, "a $3,000,000 offer from Eastern capitalists has been refused" by the inventor's attorney, Victor J. Evans, of Washington. A new touch is added, however, in smelting the copper in a vacuum so that there is even less in this process than in its predecessors.

There is a curious psychology in this business of discovering a method for hardening copper. It breeds in the inventor a supreme indifference to wealth, a haughty and scornful pride that casts aside great fortunes laid at his feet by those mythical, credulous and greedy Eastern capitalists. In this case the infection seems to have spread from Lorain to Washington—from the inventor to his attorney—for it was the latter who, according to reports, refused the $3,000,000 offer. Mr. Harrison should look into this and demand the privilege of doing his own refusing. No one wants to refuse $3,000,000 by proxy, particularly when the refusal is all he will get out of it.

As the wind bloweth where it listeth, so hardened copper springs perennially from all points of the compass and all strata of society. The more humble the stratum, the more marvelous the discovery and the more magnificent the gesture of refusing a vast fortune. In all this there is probably no great harm. True, the press misleads the public and the Patent Office is burdened with useless junk; but the scientific world is mildly amused, the patent attorney gets his fee, the proud inventor has his brief hour of newspaper fame and—in this case—also his vacuum.

New Uses for Recording Thermometers

A RECORDING thermometer has been developed in Los Angeles that charts temperature for a month or so without attention. It was designed primarily for use in connection with the refrigeration of fruit, and as a check on temperatures maintained during transportation of large shipments. It demonstrated the unsatisfactory conditions that sometimes prevail on board ships carrying fruit through regions of widely divergent temperatures. An examination of the chart of a thermometer concealed in a case of fruit shipped by railroad made it possible to determine with accuracy the exact point at which the door was opened and some of the cases stolen. Again, the protests of a cold-storage concern—that temperature had been constant over several weeks—were unavailing in the face of thermometric evidence which showed that a serious change in temperature had occurred. It was subsequently admitted that the ammonia plant had failed temporarily. A large consignment of eggs was spoiled and a successful suit for damages was instituted.

Although developed to date for low-temperature recording, the new 30-day thermometer, in modified form, will find a much wider application. The maintenance of a definite temperature for a definite period of time is obligatory in some phases of processing food products. A daily official inspection of 24-hr. charts is impracticable, and the substitution of one chart for another before the inspector arrives is feasible without fear of detection; but a valuable check on operations would be afforded if the chart from a 30-day thermometer were accessible only to the visiting official. In many phases of chemical work, especially where a definite temperature must be maintained, or where regular variations in temperature are necessary in one cycle of operations extending over several days, or even weeks, the new instrument will doubtless prove of considerable value as an aid to accuracy and as a check on the maintenance of efficient heat conditions.

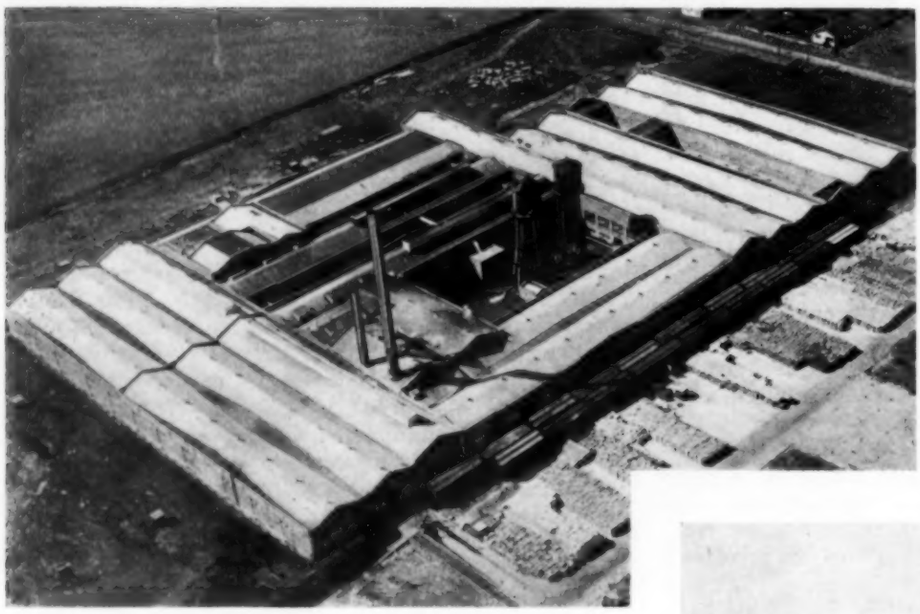
Exploiting the "Advisory Board"

IN A certain type of publicity, concerned mainly with the selling of stock or the solicitation of subscriptions, wide attention is drawn to the personnel of an "advisory board." This is one of the oldest devices of the artful promoter, but one that usually succeeds because it tickles the vanity of the "board" and impresses the innocent prospect.

A fraud order was issued recently prohibiting the use of the United States mails by a company that boasts of an "advisory board" consisting, the prospectus tells us, of "prominent engineers, attorneys, bankers, business men and others. . . . On the technical staff alone, there are over fourteen prominent engineers. Practically all of these engineers are mentioned in 'Who's Who in Engineering,' and five of them are eminent consulting engineers." The questions arise: Do these gentlemen accept any responsibility for the operations of the concern? Is their advice solicited and acted upon; or are their names merely used for letterhead decoration—as a guarantee of respectability, in other words?

Similarly, the names of eminent scientists appear on another "advisory board" in connection with which the same questions might well be asked. A league for the ostensible purpose of opposing legislation designed to suppress the teaching of evolution invariably gives newspaper prominence to the names listed on its "advisory board." Yet one wonders if the gentlemen in question were allowed to exercise their advisory powers recently in respect to holding a debate in a church, between a minister and a representative of the league, which resulted, as might be expected, in an overwhelming defeat of the advocate of evolution, interpreted far and wide as a defeat of science.

Advisory boards that advise, whose advice is solicited and acted upon, are worth while; otherwise the use of the names of distinguished men may inspire a confidence in the active direction of affairs that may prove misplaced.

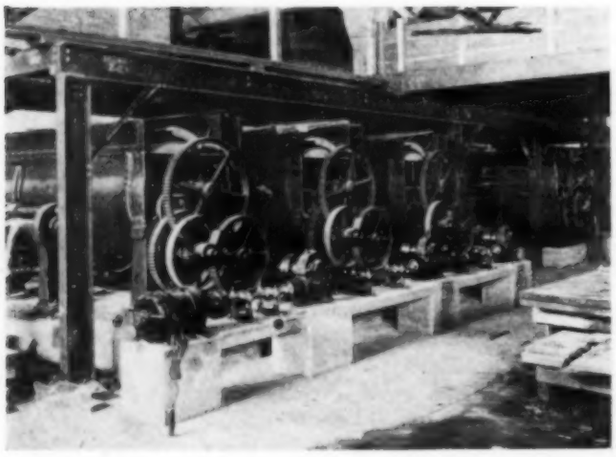


LEFT—*Airplane view of National Paper Products plant at Stockton, Calif., before construction of storage bins and installation of mechanical equipment for the handling of raw stock.*

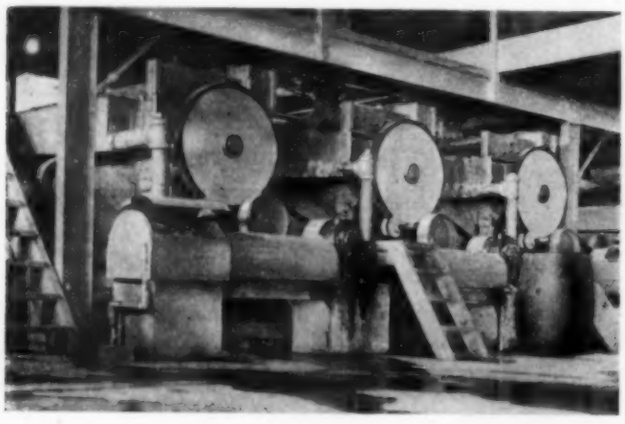
BELOW—*Gantry crane, with open-air storage of raw stock, now being replaced by storage bins, as shown in distance.*

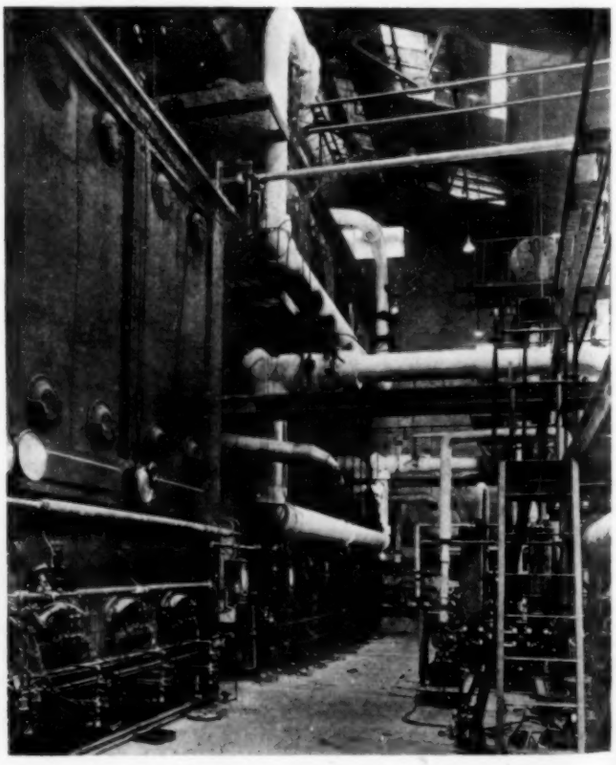
Approaching the Ideal in Plant Design

BELOW—*View of the boiler room, showing automatic fuel and damper control.*



Rotary screens, for the separation of foreign matter and the return of unpulped stock to the breaker beaters. ABOVE—*Showing drive and gearing.* BELOW—*As protected by covers in ordinary operation.*





Modernizing a Boxboard Mill

A Description of a Scheme of Technical and Mechanical Reorganization Recently Put Into Effect at the Plant of the National Paper Products Co. at Stockton, Calif.

By H. G. Ingraham
Resident Engineer for V. D. Simons, Consulting Engineer, Chicago

The rapid development of boxboard as a substitute for wood and steel in the manufacture of containers, and the use of the material for a wide variety of other purposes, has led to significant improvements in manufacture. Boxboard containers are light, strong and usually collapsible. The surface, of sized paper, is suitable for high-class color printing, giving opportunity for effective advertising. A waterproofing effect is secured by the adoption of the methods described in this article—by incorporating a layer of asphalt between the layers of paper. One interesting outcome is the use of such prepared paper in the growing of pineapples in the Philippine Islands. It is laid flat on the ground. Holes are provided through which the young plant may grow. Rain water is diverted to these holes; and weeds, which would otherwise thrive, perish for lack of sun. Waterproof paper is also used extensively in modern building operations.

WHEN the National Paper Products Co. was ready to modernize its Stockton (Calif.) division, a careful study was made of existing conditions as regards possible savings in stock handling, slush stock process, and paper-machine improvements. The installation of an electric generating power plant was also planned. The work, begun in September, 1922, extended over two years, additions to the original program being made as the benefits of the work were demonstrated. Almost every department profited to some extent, although in each the problems that presented themselves were along entirely different lines of thought than in the others. Not only were equipment changes and additions made, but the operators had to be trained to handle new apparatus and new methods of processing in order that operations would be conducted at maximum efficiency.

Those engaged in the manufacture of paper are constantly on the lookout for new machines, new processes and new methods for securing results in a more efficient manner. Sometimes it happens that large sums are lavished on a simple detail of manufacture which would be included in any comprehensive and efficient scheme of mill improvement. Too often have the praiseworthy efforts of one or two farsighted employees been nullified by petty departmental jealousies; and expenditures have been wasted on work that otherwise might have been beneficial. Few mills have the organization for effecting radical changes in equipment or processing, or for carrying out a comprehensive reorganization scheme that may extend over a period of years. This is due partly to the reason stated, and partly to the fact that changes in personnel sometimes make it difficult or impossible to carry such a proposal through to completion in an efficient manner and within a reasonable length of time.

That the expenditures were fully justified was recently disclosed at the completion of exhaustive tests and comparisons with former operating costs and methods. The flow diagrams reproduced herewith show at a glance the important changes made in the process of converting mixed waste paper to boxboards, fiber shipping cases and lithographed cartons.

Raw Stock Handling and Storage

The original plant consisted of a one-machine mill, with auxiliary equipment to produce the standard grades of container and board commonly known as chip. Later, a second machine was added, to be used partly on the better grades of white-lined and fancy boards. In order to provide a "furnish," or blend of raw materials, for two entirely different kinds of product, the new installation had to be flexible, so that frequent changes from one grade to another could be readily made.

The handling and storage of raw stock preparatory to pulping presented several interesting problems. It was necessary to cross the incoming railroad tracks when bringing stored stock up an incline from the yard to the mill. It is well known that waste-paper stock deteriorates rapidly on exposure to the weather. The increased labor cost of handling this stock was evident after storage in the open during one winter and one summer.

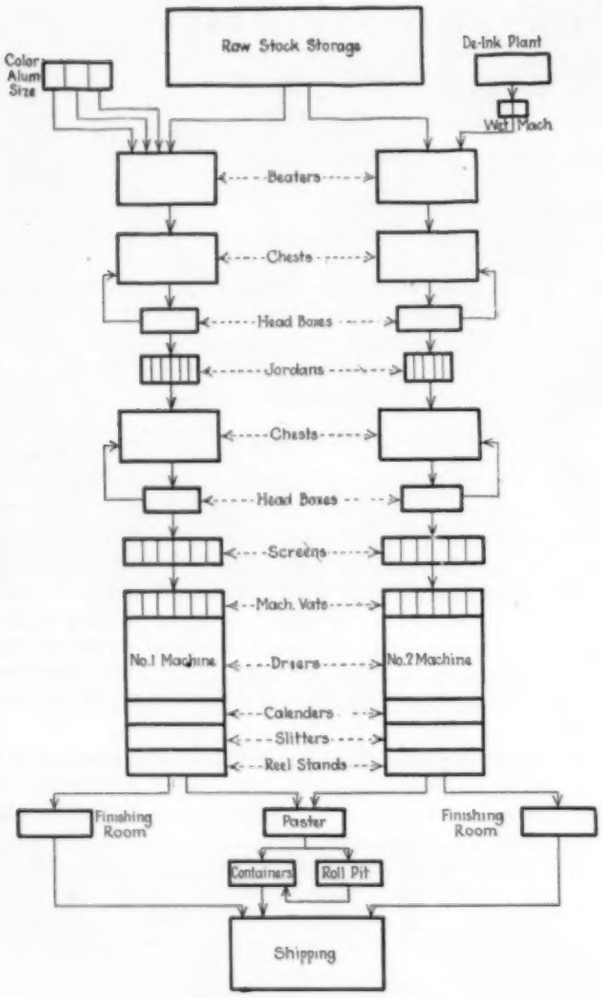
Figuring showed and experience proved that covered storage, in which the bales could be piled high one upon another, was far cheaper than if they were stored one bale high in a warehouse, assuming that efficient equipment was provided for handling. That such mechanical transportation is cheaper than hand labor was also clearly demonstrated by comparative tests.

A battery of square, high, brick storage bins was constructed, with fire walls between. These allow protection from the elements. A sprinkler system reduced the fire hazard. A traveling gantry crane was installed, which spans the bins. Loading into or out of the bins is accomplished through roof hatches with removable covers. The success achieved with this type of storage was such that additional bins were soon constructed to accommodate over 6,000 tons of baled waste paper or 16,500 tons of baled pulps. Handling costs were reduced in amount varying from 75c. to 30c. per ton.

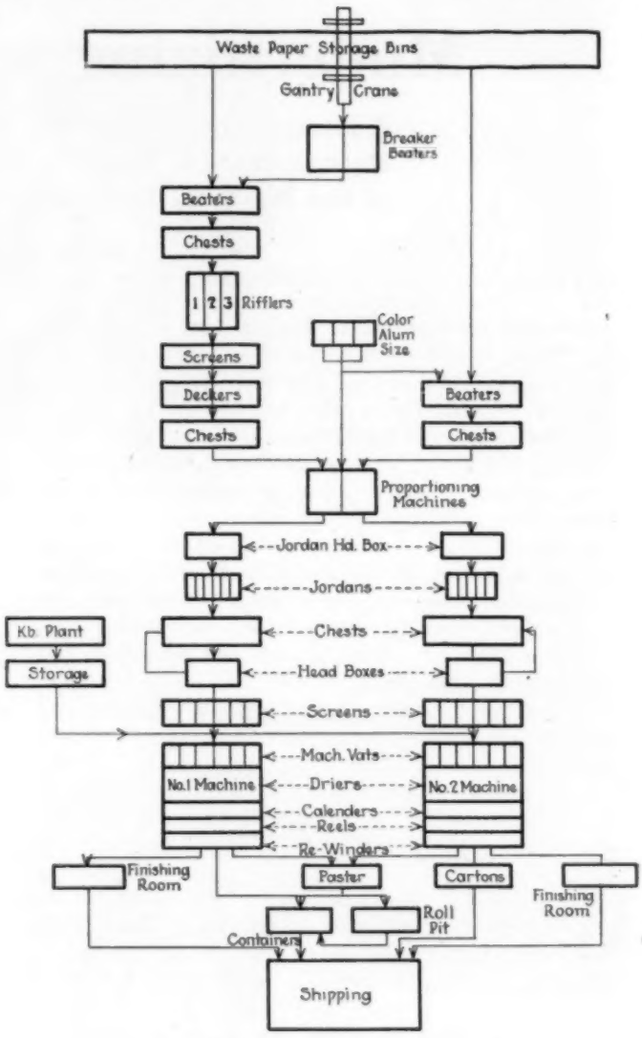
Electric trucks with lift-about trailers are used to bring the bales to the exact locations for pulping. On the short hauls, hand trucks, by which the use of these trailers is avoided, are found slightly cheaper, especially where congested conditions in the mill prevent electric-truck manipulation.

Slush Stock Process

Paper making begins in the beating machine or beater, a crude device developed in Holland over 200 years ago. Although refinements have been applied, the beater has withstood the attacks of many ingenious



Process Diagram Before Improvements



Process Diagram After Improvements

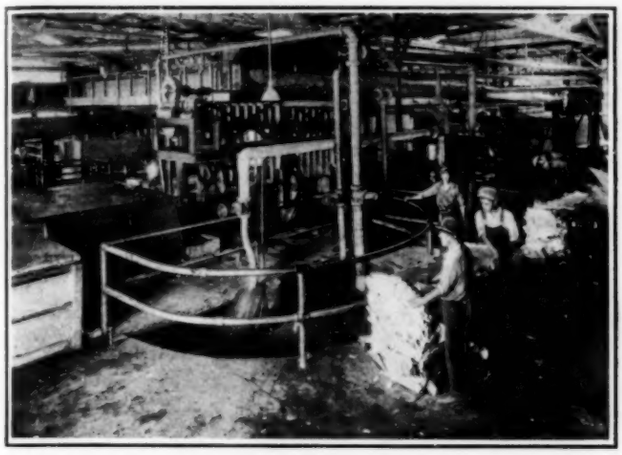
inventors and is still the recognized pulping machine in the majority of mills throughout the world. In the manufacture of boxboard, one of the principal problems is the elimination of the undesirable material that is collected and baled with the gatherings from waste-paper baskets. The cost of careful dry sorting before baling has been found prohibitive, although the waste-paper dealers have sorting conveyors from which the larger pieces of foreign matter are thrown out. The problem resolves itself into one of taking care of the refuse while the stock is in slush form, and to meet this condition the Shartle continuous breaker beater was adopted. The particular type used in this plant has a large concrete tub flush with the beater-room operating floor, so that after cutting the wires, the bales can be kicked into the tubs. This feature alone results in a great saving of labor, as compared with the former method of hand feeding into the Holland-type beaters. The rags are removed by automatic-lift trash racks, and the heavy metal settles to the bottom, where it is dumped into a large chest below during clean-out periods.

The "consistency" of breaker stock (the percentage of air-dry fiber present) usually averages 4 to 4½. Naturally the stock carries in suspension fine pieces of glass, paper clips, tacks, rubber bands and other foreign matter, even after rags and heavy materials are removed. The loss in processing is called "shrinkage" and is about 10 per cent. This includes all beater-room refuse and certain fiber losses that occur in spite of the adoption of the most efficient means of recovery.

With the former methods of pulping, in Holland beaters, the trash was found throughout the entire system, causing constant refitting of beater and Jordan fly-bars, pump breakages and clogging, and excessive labor in shoveling oversize from the machine screens. The machine cylinder vats were found partly full of sand and dirt at every shutdown, this material often being carried over, to the detriment of the finished sheet.

If this breaker stock is diluted to a consistency of 0.5 per cent or less, the metallic particles are dropped. This dilution is accomplished in a battery of large, shallow troughs called rifflers, and several kinds of stock can be handled at one time. From the rifflers it passes to specially constructed rotary screens with coarse plates, which separate the remaining foreign matter and return unpulped stock to the breaker beaters. After the screens comes a decker system, which thickens the stock to the required consistency and drops it into chests below.

The treatment described applies to the greater percentage of raw stocks used in manufacture The better grades of fancy assorted papers and raw pulps manufactured elsewhere are handled in the manner most suitable for reducing to proper refinement and con-



Shartle Continuous Beater
The top is flush with the floor operating, thereby simplifying the feeding of raw stock.

sistency. Each grade of paper has its particular formula or "furnish," in which the pulped stocks are combined in certain proportions. Colors, alum, rosin size and starch are used in varying amounts.

With the former methods, the dry stock was weighed before placing in the beaters; and, usually, the beater engineer's experience was relied upon to refine it properly. There was ample opportunity for error, resulting from unskilled beater-room labor, and furnishes were frequently made up with short or long weights on certain kinds of stocks. The fact that the furnish was wrong was not usually discovered until the paper

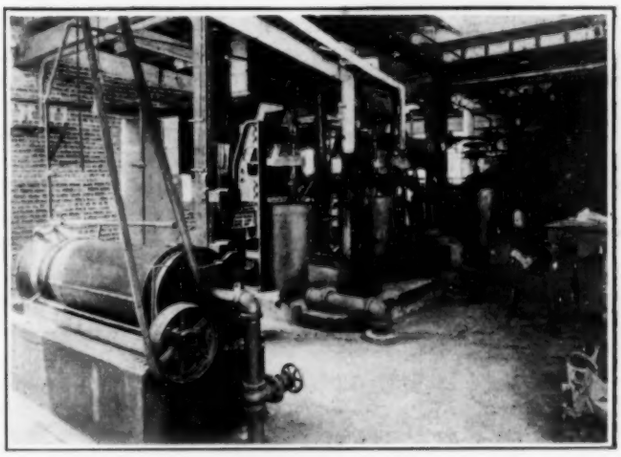
A Battery of Holland Beaters

had come off the paper machine; and in order to make a change it took several hours, even a day at times, to clear the entire system before a new furnish came over. Color, alum, and size were handled by hand in pails and dumped in the beaters.

The Trimbey automatic metering and proportioning system was installed at the Stockton plant, which mechanically combines the various stocks in slush form, depending upon the amounts required. It maintains the correct proportions by weight after meters have been set to the proper amounts, providing the consistency of the stocks does not vary. For this purpose automatic consistency regulators were put in on each of the six major grades used. These regulators are set to maintain consistencies at the percentage that can be handled the easiest. Some pulps are bulkier than others, and it is not practicable to keep all at the same percentage. Color, alum, and size are mixed and handled in liquid form, and metered in the proportioning machines.

Furnishes were formerly supplied to the beater room in terms of so many pounds of stock; these are now in terms of so much per cent of the various ingredients as a guide for meter setting. Beating time is regulated as determined by experience, and periodic freeness tests are made by the chemist. As a check on the amounts of slush stock used, daily verifications are made from the quantity of materials placed in the system in the beater room. Meter adjustments are shown by recording charts.

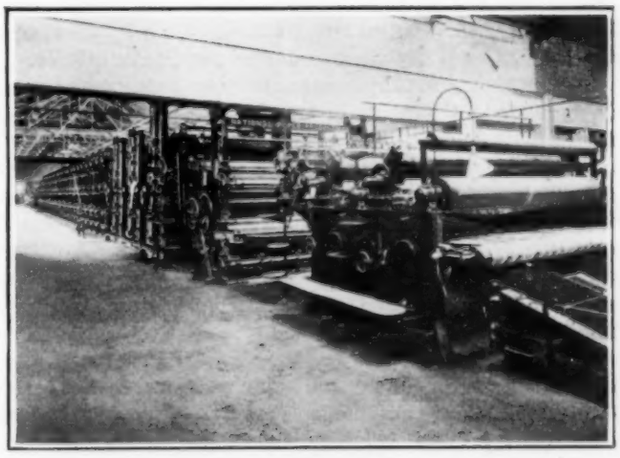
The benefits derived from this method of stock handling are shown in various ways. Greater tonnage is possible by the elimination of trash before it finds



The K-B Emulsion Plant
Here is prepared the asphalt clay emulsion as used in the manufacture of waterproof paper and board

its way into the system. Long periods of pulping under the same conditions and large chest capacity have made for uniform quality. Accurate records are now available, so that a continuous comparison of costs shows where furnish savings can be made.

In addition to radical changes in the pulping process, a thorough study was made of fiber losses with a view to reduce these to a minimum. A white-water program was put into effect, which included the use of mechanical save-all machines and the re-use of fiber-



Boxboard Rolls
Layer after layer of paper is passed through these rolls to form a board of desired body. The asphalt waterproofing medium is incorporated with the paper in this machine.

carrying water wherever possible. The use of fully a million and a half gallons of fresh water daily was avoided, and white water used in its place. The real saving became apparent when considering the lessened amount of fresh-water dilution to the rich-paper machine and beater-room effluent. The save-all machines recover an average of 2½ tons of stock per day, and an additional 1½ tons will be saved by a proposed installation.

Paper Machine Improvements

To accommodate the increased volume of available stock from the pulping department, the paper machines and auxiliaries were revamped. Gear ratios were changed, allowing greater speeds; one machine was electrified with push-button control, Jordans were motorized and new condensate-removal system installed. Other smaller changes were made in the flow-vats, presses and suction slices; and the felt conditioners were connected. A large increase in daily tonnage has been made possible by a capable management which has recognized the value of modern equipment and is taking full advantage of it. Proper control of furnish proportions and heating of stock during pulping has allowed additional machine-drying capacity. The new condensate-removal systems allow steam pressure in the driers to be reduced to a maximum of 15 lb. Steam is admitted to the dry-end section and passes into each of the other three sections in successive steps, there being a 1-lb. pressure drop between each. A vacuum pump on the end section gives a steam velocity through the driers of 7,000 ft. per minute, and condensate is removed from each section. This is returned to a common hotwell in the power plant.

Control of the exhaust steam is accomplished in the power plant, and any pressure from 1 to 15 lb. can be supplied to the paper machines. An automatic live-steam control mechanism maintains the proper pressure if engine exhaust is not sufficient. This feature has great advantages over former methods when live steam was handled by paper-machine hands, with resultant danger of too high pressure and varying temperatures on driers. On certain grades of fancy boards on one machine a small pressure is sometimes sufficient. A diaphragm control valve operated by air pressure takes care of this nicely. In addition to the exhaust-steam system, each paper machine is arranged so that a section of driers on the dry end can be furnished with live steam to a maximum of 30 lb. This is used only when additional drying is required for heavy grades.

Recently a specialty boxboard was developed, using an emulsion of asphalt and clay. This process, known as the K-B (Kirschbaum-Bellknap), gives a waterproof or moisture-proof product. The board is rapidly being adopted for use in containers where the exclusion, retention or stabilization of moisture, in its relation to the contents of the package, is desired, such as in handling dried fruit. It also has many particular advantages as a building paper, and its use is spreading to other fields.

The K-B installation was designed for a paper production of from 150 to 200 tons of finished board per day, and the equipment comprises two standard emulsifying units with the necessary supplementary equipment to serve the full capacity of the paper machines. The installation is housed on two floors in one of the paper-storage buildings, 400 or 500 ft. from the machines. The emulsion produced is piped from the receiving tanks to storage tanks adjacent to the paper machines. The emulsifying units are each capable of converting from one to one and one-half tons of asphalt per hour into emulsion form. Supplementing these emulsifiers are the necessary melting kettles for preparing the asphalt; receiving and storage tanks were also provided for treating and storing the emulsion, preparatory to delivery to the paper machines.

The receiving and treating units comprise a battery of four mechanically-agitated 2,000-gal. tanks. The storage tanks were installed close to the paper machines, each being provided with a storage tank of 5,500 gal. capacity, with connections permitting service to either or both machines.

The emulsion is delivered from the storage tanks to the paper machine by gravity, and the flow and quantity is accurately controlled through a weir box, by means of which a uniform and regulated quantity of emulsion is diverted to the paper machines.

The K-B emulsion enters the paper-making system just before the flow vats, and is piped to the suction side of the fan pumps. It is here mixed with the return water and with the stock as it enters the screens, and a uniform mixture of asphalt emulsion and paper stock is produced.

The mixture flows to the vats and is formed in the usual way on the cylinder molds. The emulsion may be introduced into as many vats as desired, usually it is necessary on not more than two of the inner molds. By regulating the quantity of the asphalt and the character of the stock, the resultant product may be made waterproof or moisture proof.

Power Plant

As the power plant is the heart of any industrial plant, it is usually the place where profits can be quickly dissipated; or, conversely, where efficient methods will show satisfactory returns. It is not a place where losses or gains are readily apparent; and a period of months is often required to obtain the necessary information. Problems in the design of industrial power plants differ from those met with in central generating stations, chiefly in regard to the distribution and use of exhaust steam for process requirements. Prime movers most efficient in the generation of electricity only are out of place where back-pressure operation is desired. To my knowledge, there is no generating equipment which can approach the economy of a uniflow engine when operating against 16 lb. back pressure, as used in the National Paper Product's plant at Stockton.

The original installation consisted of reciprocating steam engines, the exhaust from which was insufficient for drying paper and other requirements. This necessitated the addition of much live steam. Besides this, all electrical power was purchased from an outside distributer; service was unreliable and many expensive shutdowns resulted. Boiler-water troubles, inefficient furnaces, wastage of condensate, lack of heat balance and other troubles indicated the opportunity for improvement in the power plant. Three of the former five low-pressure boilers were removed and two high-pressure boilers substituted, with superheaters to furnish steam direct to a twin-cylinder uniflow engine with direct connected generator. Steam is supplied at 300 lb. pressure and 200 deg. superheat. The boiler

auxiliary equipment is of the most modern type, including a water-softening plant, condensate oil-filtering plant, radiant-heat superheaters, steam purifiers and boiler furnace equipped for oil burning with the latest development of vertical firing retort.

As the fluctuations in electrical demand are greater than the demand for exhaust steam, a condensing turbo-generating unit takes care of the peaks. The engine and turbine run in parallel, with the engine only generating such power as is sufficient to supply exhaust steam requirements, the balance being automatically supplied by the turbine. Perfect regulation is accomplished by duplex automatic devices called pontoons, which operate from the engine back pressure. A variation of ½ lb. below or above the pressure desired makes an electrical contact which operates small d.c. motors on each engine governor and shortens or lengthens its cutoff. In this manner economical operation is secured. The turbine governor must follow the load changes quickly, whereas the engine governor must be more static and hold a given part of the load steady while the total plant load is fluctuating.

By the installation of recording and integrating instruments, a correct distribution is now made of steam and electrical power for accounting purposes. Continuous daily records are kept of efficiencies and distribution made, based on heat utilized by the various machines. Steam and electric power are reduced to the common B.t.u. denominator, and the power house really has become a separate corporation, "selling" its wares to the mill and giving credit for heat returned in the form of condensate. Although the cost of generating electrical power is not materially cheaper than that purchased from the outside, it is in the value of the exhaust steam that savings are apparent. The fuel oil needed, in barrels per ton of finished paper, is about the same as when all power was purchased.

There is no doubt that the full return from improvements has not yet been reached in all departments, due to the gradually increasing skill of operators. The whole organization underwent a thorough tuning up after the major portions of the expansion program had been completed. Present results were not secured overnight; and many weeks of tireless experimenting in some instances were necessary to prove the merits of certain features of the installation. Process and power problems were encountered which commanded deep study and hard work to overcome without causing a plant shutdown. Construction crews put in long hours on Sundays to make pipe changes and to do other work without loss of production. The value of a definite and co-ordinated scheme has been thoroughly demonstrated by comparison with previous operating costs, and it has been shown that only by modernization can a plant hold its own with the high standards of efficiency being set in the paper industry today.

Correction

In the article "Change in Concentration of Electrolytic Impurities, vol. 32, No. 14, p. 700, formula (2) should read

$$C = \frac{W}{R}\left(1 - e^{-\frac{Rl}{V}}\right),$$

and in succeeding formulas, l should be 1.

Electric Furnace Process for Sodium Sulphide

New Method Yields a Commerical Product of 90-95 Per Cent Purity

THE common method of producing sodium sulphide by the reduction of salt cake sodium sulphate with coal has been the subject of a great deal of discussion (see *Chem. & Met.*, vol. 28, pp. 49, 199, 290, 338 and 530) both because of production difficulties and the fact that the process can not ordinarily be made to yield an anhydrous product. The reason for this is that at a certain stage in the reduction (when the product contains about 65 per cent of sodium sulphide), the mass suddenly solidifies and further heating will not remelt the material.

In a paper recently presented before the Dominion Convention of Chemists, at Guelph, Ontario, Horace Freeman of Shawinigan Falls, Quebec, described a new electric furnace process that gives a product containing 90 to 95 per cent of Na_2S. In the work carried out by the Canadian Carbide Co. at Shawinigan Falls it was found that the addition of a small amount of potassium sulphate caused the charge to remain liquid at all stages, which is the essential condition for securing complete reduction of the sulphate.

Manufacturing difficulties were experienced at first because of the fluxing action of the molten sodium sulphide on the refractories. When, however, a water-cooled furnace shell was substituted for the refractories, it was possible to obtain a high-grade anhydrous product on a commercial basis. The molten material is tapped from the furnace, cast into pigs weighing about one ton, cooled and crushed. The screened lumps are packed into steel drums and, being free from dust, are said not to be subject to spontaneous combustion. The screenings are used to produce the usual 60 per cent grade.

A New Oregon Industry

Steam Distillation of Sawdust Yields Oil Having Medicinal Properties

A valuable byproduct—oil—is now being made from the sawdust produced at the lumber mills at Marshfield, Ore., which use what is known as Port Orford cedar. The oil amber colored, turns water-white on exposure to the light and possesses marked medicinal properties. It is not a true cedar oil, and no domestic market could be arranged after the technical name of the species from which it is made was supplied. Germany, however, was less particular; and the entire output now goes thither, for uses that are unknown here. The oil has a specific gravity of 0.9, and may be used as a perfume, insecticide, embalming fluid or for the impregnation of other woods.

The process adopted was described by Professor F. E. Rowland of Oregon State College, at the summer meeting of the A. C. S. at Los Angeles. The sawdust is charged into one of three vats, each 6 ft. diameter by 8 ft. high, which is then covered. Steam at 110 lb. pressure is introduced into the bottom, and the oil distilled off and recovered, the residue being subsequently used as a fuel. The plant started operations in March, 1925; and in the intervening five months all capital and operating expenses have been met from the proceeds. An addition is planned, whereby an output of 3,000 lb. per day is expected.

Electrochemists at Chattanooga

Fall Meeting of the Society Featured Relation of Electrochemistry to Production of Fertilizer Materials—Muscle Shoals Dam Inspected

Editorial Staff Report

WHEN Paul J. Kruesi, President of the Southern Ferro-Alloys Co., extended an invitation to the members of the American Electrochemical Society to meet at Chattanooga, it was at once accepted with unanimous and enthusiastic accord. Signal Mountain Hotel was selected as headquarters and here all of the technical sessions and many of the social functions were held. It was the 48th national meeting of the Society and one of the most enjoyable and instructive ever held. The last day of the convention, Saturday, September 26, was spent at Muscle Shoals where the giant powerhouse had but recently put into operation the first of its eighteen 35,000-hp. generating units. The social features of the meeting were characteristic of southern hospitality and added greatly to its success.

Thursday morning and afternoon were devoted to the symposium on fertilizers. Past President H. C. Parmelee presided. The introductory paper by Dr. Charles O. Brown of the Nitrogen Engineering Corporation of New York referred to the early predictions of Sir William Crookes as to the constantly growing consumption of Chile nitrates and other natural deposits; how the nitrogen problem shortly became a world affair and how by 1915 the fixation of atmospheric nitrogen assured an almost unlimited supply of nitrates and ammonia. Today the fixation industry has advanced its processes to such a degree of commercial perfection that the air products and the natural deposits are in direct competition. With hydro-electric power at $6 a hp.-yr. dry ammonia gas can be produced according to Dr Brown for 2.25c. a lb. in large plants using large units. With power at $35, the cost would be 4.4c. a lb. Since however, ammonia cannot be applied to the soil directly, a cheap chemical compound, cheaper than the present ammonium sulphate, is very much desired.

Commenting on Dr. Brown's paper, Charles S. Bradley referred to his own researches with Lovejoy at Niagara Falls (1896 to 1904). They had, years ago, arrived at the conclusion that the fixation of nitrogen had best be carried out chemically rather than electrically. Mr. Bradley predicted that electric power would soon be worth at least $40 to $50 a kw.-yr. on account of the rapidly increasing demand for electrical power for mechanical purposes, transportation, etc. Bradley and Lovejoy had also "fixed" nitrogen in the flame of the oxy-hydrogen blow pipe, the yield being fully equal to that of the electric arc.

Mr. Bradley referred to Robert Bunsen's book on Gasometry (1857) and the statement therein that "nitrogen can be easily made to combine with oxygen to form nitric acid by exploding both gases with double their volume of a mixture of two volumes of hydrogen and one of oxygen." Bunsen got a yield of 11.44 per cent N_2O_5, which is an exceptionally high yield. Recent experiments confirm Bunsen's findings. Bradley has improved upon this process and with the introduction of cheap oxygen "none of the other fixation processes can by any possibility compete with it." (See U. S. pat. 1,134,583, Apr. 6, 1915.)

Dr. J. M. Braham of the Fixed Nitrogen Research Laboratory, Washington, in his paper on "The Fixation of Atmospheric Nitrogen" pointed out that over two-thirds of the atmospheric nitrogen fixed today is by the ammonia process. Dr. Braham prepared a set of interesting curves which were projected on the screen and demonstrated clearly the growth and trend of the fixation industry. The annual production for 1925 is estimated at 550,000 tons of fixed nitrogen; synthetic ammonia furnishes 375,000 tons, cyanamide 130,000 and the arc processes, 40,000 tons.

Dr. Braham referred briefly to the new and very interesting method for the production of hydrogen for ammonia synthesis now being developed by the Phosphorus Hydrogen Corporation at Niagara Falls, N. Y. Elemental phosphorus is produced in an electric furnace from a charge of phosphate rock, sand and coke; then the phosphorus is treated with steam in the presence of a catalyst, thereby producing hydrogen and phosphoric acid. The phosphoric acid is brought into reaction with

synthetic ammonia to produce ammonium phosphate.

The only commercial arc process fixation plant in America is that of the American Nitrogen Products Co. of Seattle, Washington. A paper by H. K. Benson describing the plant and process is printed elsewhere in this issue.

Dr. S. Karrer of the Fixed Nitrogen Research Laboratory, Washington, discussed the theoretical basis of "The Electric Arc Process of Nitrogen Fixation" and dealt at length with modern conceptions of intermolecular and interatomic reactions. Only 2.5 per cent of the total energy consumed in the arc process is resident in the nitric oxide formed. F. M. Becket emphasized the great difference in cost between nitrous oxide and nitric oxide formation. Had Bradley and Lovejoy been content with nitrous acid, their plant would have been a commercial success. Professor Farrington Daniels complimented Dr. Karrer upon his clear exposition and referred to his own researches on arc fixation of nitrogen. In the somewhat analogous reaction, the production of ozone, experiments at the University of Wisconsin have indicated that, at low pressure, the chemical character of the electrode is of considerable importance. Catalytic effects in low pressure discharges are not impossible in the synthesis of nitrogen oxide. It is true, however, that past experiments on nitrogen fixation with cold electrical discharges have been disappointing. F. G. Clark consulting engineer of Toronto, suggested that a more thorough study of the use of oxygen-enriched air might be of decided advantage.

Wm. G. Allan of Toronto submitted a paper on "Hydrogen and By-Product Oxygen in Relation to Nitrogen Fixation and Fertilizers." Mr. Allan has devoted many years of research to the production of cheap, pure hydrogen which resulted in the development of a highly efficient electrolytic cell (U. S. Pats. 1,502,707; 1,513,728; 1,496,966; et al.). Pure hydrogen is essential for the synthesis of ammonia and electrolytic hydrogen is preferable to hydrogen produced by either the iron contact or the water gas process. Many of Allan's experiments were carried out on a large commercial scale. The electrodes of the new cell are made of wire cloth; the diaphragm consists of high-grade asbestos cloth. The purity of the hydrogen produced is 99.95, and that of oxygen is 99.8 per cent.

The Bureau of Soils, Washington, took a very active part in the symposium and contributed valuable and enlightening discussion. Dr. K. D. Jacob of the Bureau outlined "The Development of Volatilization Methods for the Manufacture of Phosphoric Acid." A large portion of the phosphatic fertilizer is still made by the old Liebig-Lawes methods. In the volatilization process for the production of liquid phosphoric acid, as carried out commercially by the Federal Phosphorus Co. at Anniston, Alabama, a mixture of phosphate rock, sand and coke is heated to 1,600 deg. C. in an electric furnace. A Cottrell precipitator is used to recover the volatilized P_2O_5. A recent modification of this process consists in the substitution of an oil-fired furnace in place of the electric furnace. It is difficult to attain 1,600 deg. C. in fuel fired furnaces. However, recent tests carried out by the Bureau of Soils indicate that the phosphate rock-coke-silica mixture will react at as low a temperature as 1,200 deg. C. This research is still in progress.

In further commenting on the phosphatic fertilizer industry, Dr. Jacob stated that machinery and methods for the manufacture of acid phosphate had about reached that stage of perfection whereby a further reduction in the present low price of the material may hardly be expected. In fact, it is entirely logical to expect the future to bring somewhat higher prices per unit of plant food in acid phosphate. Freight rates constitute a very important factor in the final price paid for fertilizers by the consumer. The solution of this problem, particularly as regards long distance hauls, depends entirely upon the development of cheap methods for the production of liquid phosphoric acid, which may be combined directly with ammonia or potash to produce the concentrated soluble phosphates, or may be used to treat further quantities of phosphate rock to produce monocalcium phosphate.

Concentrated Fertilizers a New Development

The economic necessity of developing the production and utilization of concentrated fertilizers was likewise emphasized by Dr. R. O. E. Davis, of the Bureau of Soils, in his paper on "The Development of Fertilizer Practice" and by Dr. William H. Ross of the Bureau describing the "Use and Preparation of Concentrated Fertilizers." Dr. Davis showed that the three most essential elements for a fertilizer are nitrogen, phosphorus and potash. Lately there has been a decided trend towards the preparation of concentrated fertilizers and the establishment of the fertilizer industry on a strictly chemical basis. The elimination of fillers means a great saving in freight charges. Most of the fertilizer now consumed in this country is consumed in the East and Southeast, but with the introduction of concentrated fertilizers and consequent lower freight rates, the territory is bound to be extended.

Dr. Ross described the tests carried out by the Bureau of Soils at Washington. It was here that the conception of "concentrated fertilizers" originated. They give promise (1) of providing a means for saving on freight, (2) of conserving organic ammoniates, and (3) of affording the most economical means of utilizing volatilized phosphoric acid and the fixed nitrogen products. The most concentrated fertilizers are made from mixtures of ammonium phosphate, potassium phosphate and potassium nitrate. Dr. Ross mentioned the properties of these materials, and of urea and ammonium nitrate. Field tests with various concentrated fertilizers are now being made in different parts of the country by the U. S. Department of Agriculture. The concentrated fertilizer materials, ammonia, urea, nitric acid and phosphoric acid, are products or by-products of the electrochemical industries.

This topic of concentrated fertilizers evoked a large amount of discussion. The manufacture and application of urea occupied the centre of the stage. President Becket referred to tests made by his company at Niagara Falls indicating that urea was an exceptionally good fertilizer compound. Experimental production in a pilot plant is described elsewhere in this issue. One difficulty is the hygroscopicity of urea. The more impure, according to Becket and others, the more hygroscopic. But even practically pure urea requires a conditioner.

The use of ammonium nitrate in concentrated fertilizers was touched upon by Dr. R. O. E. Davis of the Bureau of Soils and others. The Bureau has found ammonium nitrate to be the most hygroscopic of all the fertilizer salts.

What appears to be a more suitable and effective

ammonia salt for concentrated fertilizer practice is ammonium phosphate. Dr. Sem reported that the Badische Anilin & Soda Fabrik had but recently bought a factory for the production of ammonium phosphate, the raw materials to be Haber-Bosch ammonia and electric furnace phosphoric acid.

Professor H. J. M. Creighton and Warren H. Ogden of Swarthmore College submitted a short report on the "Disintegration of Carbon Anodes in Aqueous Solutions of Nitric Acid.." Upon the electrolysis of strong aqueous solutions of nitric acid between carbon electrodes the anodes disintegrated explosively. Experiments indicate that the explosions are probably due to a pressure developed in the interior pores of the electrode, as a result of the combined action of the acid and electrolytic oxygen on the carbon. Possibly graphitic acid is formed in the earlier stages of electrolysis and subsequently explodes, forming CO, CO_2 and water.

Dr. George M. Enos of the University of Cincinnati investigated the effect of chromium plate on cementation of steel. He found that for the ordinary time and temperature employed in case hardening the plate effectively prevents cementation. Dr. Wm. Blum of the Bureau of Standards reported that the Bureau's tests on Cr-plated steel indicated that the metal was from 9 to 10 times as hard as nickel plate. It was the hardest metal so far tested.

Electrodeposition of Copper-Nickel Alloys

This investigation had been carried out by H. D. Hineline of the Radio Corporation of America and W. B. Cooley of Indianapolis. The bath contained fairly high concentrations of the mixed double copper and nickel cyanides, 50 to 150 g. per l. It was found possible to deposit coatings having a wide range of composition from almost a full copper red to a white alloy. Satisfactory anode corrosion was obtained upon adding from 5 to 40 g. per l. of KCl. The bath must be worked at a low temperature, preferably below 18 deg. C. Very high current densities, as high as 25 amp. per sq.dm., are usable. An unusual cathodic cleansing of greasy, varnished or rusty work was observed, due probably to hydrogen. The resulting deposit of mixed metals was found to be extremely ductile, suggesting an unusual state in the metal.

C. T. Thomas and Wm. Blum of the Bureau of Standards found it practically impossible to eliminate pit holes in nickel deposits of ordinary thickness (about 0.0002 inch). With the pit holes present corrosion invariably occurs. The only practicable method of increasing the protective value of the nickel is by the use of thick coatings, 0.001 inch in thickness and more. Geo. Dubpernell of the Chemical Treatment Co., New York, attributed the presence of most of the pores or pits to imperfections in the base metal. More care in the preparation of the surface preliminary to plating eliminates many of the pits. A preliminary plate of copper also tended to reduce the number of pits in the subsequent layer of nickel.

H. Beeny, Master of Metallurgy, Sheffield, England, observed the successive steps in corrosion under the microscope. He finds that manganese sulfide when present in the steel, appears to stimulate corrosion, but manganese carbide has little or no effect.

Professors H. K. McIntyre and George C. Cox, of North Carolina State College, opened the session Friday morning with an account of their experiments on a "Double Current Electrolytic Furnace." The authors showed diagrams of a new type of furnace combining the electrolytic principle of the aluminum cell with the heating principle of a slag resistor furnace. Direct current is fed in between vertical electrodes, and the heating or alternating current is fed in between horizontally placed electrodes. Electrolyzing bauxite-fluoride solutions in this furnace produced aluminum metal readily at a d.c. voltage ranging between 4.5 and 6 volts. A charge of garnierite yielded a silicon-iron-nickel complex containing 40 per cent nickel. Malachite could be more readily reduced in this double current furnace than in a corresponding a.c. furnace. When treating mixtures of malachite and hematite a fair separation was obtained, the cathode product containing 90 per cent copper.

A small furnace was designed and built by J. R. Cain and A. A. Peterson of the Bureau of Standards. The furnace is operated inside an evacuated bell jar; the base plate is bakelite; crucibles are made of magnesia or zircon. The melting coil and the high frequency generator are of the Ajax-Northrup design. John A. Seede reported upon developments in small high frequency furnaces made by the Ajax Electrothermic Corporation. One of these new furnaces was rated at 250 watts, had a conducting crucible that would melt several grams of material and operated at a frequency of about 2,000,000. The other larger furnace, of a frequency of 300,000 cycles, was rated at 1,500 watts.

Professor G. A. Roush and M. Miyake found that the solubility of alumina in cryolite in solid solution extends to about 12 per cent and of cryolite in alumina to about 77.5 per cent. These points were confirmed by metallographic examination.

Papers on Electrothermics

Professor H. C. Kremers and John Wierda, of the University of Illinois, presented another of the Urbana classics on the rare earths. This present paper was on the "Preparation and Properties of Metallic Praseodymium." High-grade praseodymium material was prepared by fractionation with a probable purity of 99.7 per cent. The impurities known to be present were 0.02 per cent neodymium and less than 0.01 per cent lanthanum. The average magnetic susceptibility of this oxide was 13.28×10^{-6}. Fifty-six grams of metal was prepared by electrolysis of the anhydrous chloride. The metal is silvery white, corrodes rapidly in air, is slightly attacked by hot water, and vigorously attacked by mineral acids and free halogens. The kindling temperature is 290 deg. C. The metal is not pyrophoric. The Brinell hardness (500 kg. wt.) is 25, specific gravity 6.60 (25 deg. C.) and melting point 940 deg. C. (Muthmann). Alloys with most common metals are readily formed.

One of the most important papers contributed was that by Norman B. Pilling, formerly of the Westinghouse Company, on the "Electrical Properties of Copper-Nickel-Manganese Alloys." A very exhaustive investigation of a wide series of alloys was undertaken and the results carefully plotted and interpreted. The new group of alloys contains about 50 per cent nickel and 30 per cent manganese, balance copper. The specific resistance is about 2.5 times that of either manganin or advance. It has a low thermo-electric force against copper and a low temperature coefficient not restricted to a narrow range of temperature.

Manufacture of Fertilizer Urea on a Tonnage Basis

Pilot Plant at Niagara Falls Gives Promise for The Development of This First Synthetic Organic Chemical Into a Commercial Fertilizer Material

By R. S. McBride
Assistant Editor, *Chem. & Met.*

DEVELOPMENT of any rare or laboratory chemical into an industrial material available in large tonnages always contains an element of the dramatic. But few cases can even approach in interest the possibilities suggested in the manufacture of urea on a commercial scale. This material in 1828 was made by Wöhler synthetically from cyanic acid (CONH) and ammonia and became the first product peculiar to the animal organism to be made in the laboratory by purely synthetic means. Now this material, which the U. S. Department of Agriculture characterizes as "an almost ideal nitrogen carrier for all types of soils," promises to become available for this use. In any event the pilot plant of the Union Carbide Co. at Niagara Falls has reached the stage of producing the material in chemical engineering equipment of a strictly commercial type, on a tonnage basis and at costs that are exceedingly encouraging.

Why Urea Was Developed

For many years cyanamide has provided fertilizer nitrogen to the world market at the lowest price per unit of nitrogenous plant food and on this basis only Chilean nitrate and byproduct ammonium sulphate have approached a competitive relation. Nevertheless the agricultural results obtained from cyanamide have varied with the conditions under which it has been used. In comparison, Chilean nitrate and ammonium sulphate afford greater satisfaction with less experience and care in agricultural application. The manufacturers of cyanamide have been generally aware of the disadvantages associated with the product and have long known that the varying behavior arises from the ease with which cyanamide transforms itself into a number of other compounds of nitrogen. Of the simple derivatives urea has long been recognized as by far the most desirable by reason of its uniform action under agricultural conditions, a chemically neutral behavior in fertilizer mixtures, and excellent plant-feeding qualities. For a decade or longer research in many quarters has sought a simple and economical process characterized by a high nitrogen efficiency for converting cyanamide to urea of the purity required in agriculture.

Johann H. Lidholm, who had been associated with the cyanamide industry of Sweden, conceived the process which converts the calcium cyanamide into urea by a simple succession of chemical operations. This process, which was developed and patented during the period immediately following the war, had decided advantages over other processes using calcium cyanamide, in all of which the first product was gaseous ammonia. Of course such ammonia was a valuable prospective fertilizer constituent, but it cannot be used until "fixed" either as ammonium sulphate, ammonium phosphate, or in other solid form suitable for mixing and distribution on the land.

Recognizing the advantage of urea as both the first and final product, the Union Carbide Co. made a preliminary investigation of the Lidholm process in

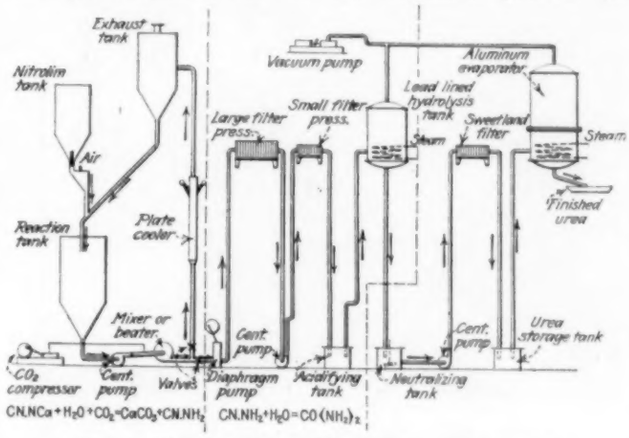


Fig. 1—Flow Sheet for the Lidholm Urea Process

Europe during 1921 and later conducted further development work in the United States. Experiments were undertaken on a laboratory scale, and in 1924 a pilot plant for testing the Lidholm process was erected at the Niagara Falls works of the company.

The Lidholm process itself begins with the utilization of calcium cyanamide. This material is made by the well-known process for treating calcium carbide, an electric-furnace product made from coke and lime, with nitrogen which is usually made by the fractional distillation of liquid air. The calcium cyanamide is treated by a few simple chemical processes which are conducted in standard chemical engineering equipment in accordance with the flow sheet given in Fig. 1.

In the initial step of the process free cyanamide is formed by the action of carbon dioxide on calcium cyanamide suspended in water. The desired reaction is: $CaCN_2 + H_2O + CO_2 = CN.NH_2 + CaCO_3$.

Free cyanamide is very active chemically and the formation of the solution containing it must be conducted within suitable limits of temperature and alkalinity. By reason of the same activity even the neutral solution soon forms undesirable nitrogen compounds and the conversion to urea must be made as promptly as possible. This is done through hydrolysis induced by a small addition of sulphuric acid. The acid is then removed almost quantitatively by treatment with calcium carbonate and filtration. The filtrate is evaporated to a syrup which is molten urea containing a small percentage of water together with negligible

impurities. According to the treatment of the melt, the urea is obtained in cake or granulated form.

The pilot plant at Niagara Falls does not include the manufacture of calcium cyanamide because the technique of that operation is already thoroughly established. The operation begins, therefore, with calcium cyanamide as raw material and follows the flow sheet of the Lidholm process already outlined. The plant has been operating on a development basis for several months, has conclusively demonstrated the technical soundness of the process, and has afforded a sufficient basis for larger plant designs and for estimating the costs of large-scale production.

In the development care has been taken to avoid using special equipment wherever possible. The pumps, mixers, filter presses, reaction tanks, and vacuum pan are practically standard chemical engineering units. Hence the cost of this equipment and its producing

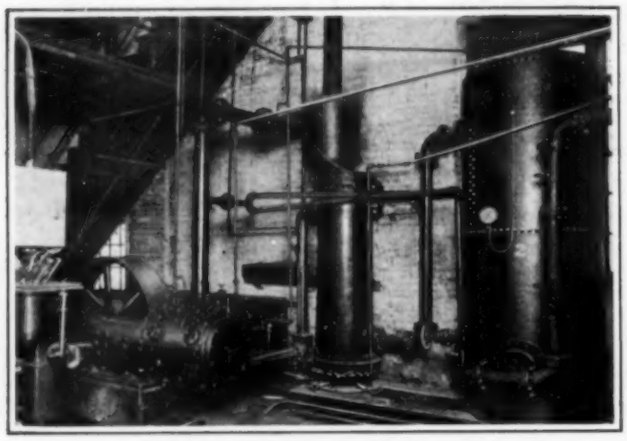


Fig. 2—Gas Compressing Unit
The CO_2 compressor is shown at the left, the after-cooler is in the center with the moisture trap directly above, and the gas receiver is on the right.

capacity could be closely estimated even before the pilot plant was built. The design and assembly of a large scale plant would be correspondingly simple. The mixing tank in which the powdered calcium cyanamide is dissolved in water is somewhat novel, but the performance and operation had been well established on an industrial basis in other processes. The other unit device of unusual sort is the beater, a 5-stage centrifugal pump so modified that very active agitation and intimate mixing of the carbon dioxide and the cyanamide suspension is attained. However, this modification did not require any radical change in the form of pump and no difficulty has been experienced in operation.

The important developments at the Niagara plant have concerned operating technique. For example, the limits within which temperature and alkalinity must be maintained during the carbon dioxide reaction have been accurately determined here on a commercial scale. The limits indicated are rather narrow but can be met in commercial operation with moderately skilled labor. Similarly the concentration at which addition of the nitrolim should be stopped has been closely determined. It is found that about 18 per cent of cyanamide, equivalent to 12 per cent of nitrogen in the solution, marks the best upper limit of concentration in the mixing system.

What is most important is that the pilot plant has demonstrated the ability of the Lidholm process to produce urea sufficiently pure for fertilizer use. It has long been known that urea could be made in this fashion, but it was not known whether the percentages of guanyl urea and of dicyano-diamide could be maintained low enough under commercial conditions. Pure urea contains about 46.6 per cent nitrogen; the pilot plant has made many tons of product containing over 44 per cent total nitrogen. Of this 41 per cent is in the form of urea and 1 per cent in the form of ammonia compounds; both of these forms are wholly available as plant food. About 1.5 per cent is nitrogen in the form of guanyl urea, which is not generally rated as available nitrogen but can be slowly used by plants. Only a fraction of 1 per cent occurs in form of the objectionable dicyano-diamide.

The physical properties of any fertilizer material are of course exceedingly important. It was necessary, therefore, to determine whether urea could be prepared in a condition appropriate for mixing in fertilizers or for use alone as a fertilizer. Where the urea is to go to a mixing plant it can be shipped in drums which are filled by simply casting the molten urea directly from the evaporator. Such cast chunks must, of course, be ground before mixing and the physical form thus obtained is not the most desirable since the ratio of surface to weight is larger than necessary and the ma-

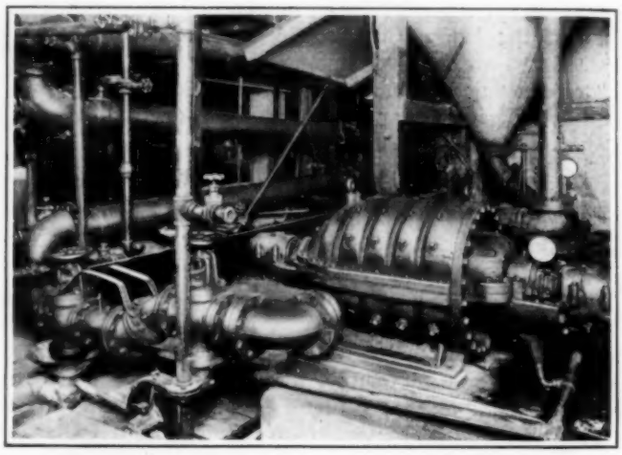


Fig. 3—Reaction Unit for First Step in the Manufacturing Process
The 5-stage mixer or beater is in the center with the cone-shaped bottom of the reaction tank showing at upper right. The welded pipe cooler is above at the left. The circulating pump is barely visible behind the beater while the small centrifugal pump in the foreground is for withdrawing the products of the reaction.

terial is slightly hygroscopic under conditions of high humidity.

In order effectively to inhibit the tendency of moisture to cake the urea, Lidholm in connection with his development of the urea process had developed a method of "spheroidizing" the material. This is done by atomizing the stream of molten urea (or urea syrup) with a blast of cold air as it flows from the vacuum pan. The urea is thus divided into minute droplets which cool and solidify as they fall through the air, forming tiny spheroids the surface of which is practically glazed. With careful manipulation the spheroids are of uniform size suitable for use in a mixed fertilizer or for direct distribution on the farm. A somewhat similar scheme was recently developed independently by the investigators of the Bureau of Soils working at the Arlington Experiment Station, Arlington, Virginia.

Urea contains a higher percentage of nitrogen than any other plant food now made. The continued use of Chile nitrate and ammonium sulphate leaves in the soil

objectionable accumulations of alkali and acid respectively. The absence of residue marks an outstanding advantage of urea.

Many investigators have compared urea with standard nitrogenous fertilizers and with others less common, both in pot and field tests, and they rate urea with Chile nitrate and ammonium sulphate in plant-feeding value. Extensive tests have been made by members of the Fixed Nitrogen Research Laboratory and the Bureau of Plant Industry of the U. S. Department of Agriculture. In a joint report (U. S. Department of Agriculture Bulletin 1180) their conclusions regarding urea are as follows:

> Urea seemed to be as readily available as sodium nitrate and equally as good in all respects as any other material used. Since urea is an excellent material physically and leaves neither a basic nor acid residue in the soil it should prove to be an almost ideal nitrogen carrier for all types of soils.
>
> It should be noted that nearly all the fertilizer materials tested have a much higher plant-food content than those now commonly employed. While some of these materials are suitable for direct use in mixed fertilizers, others will require some modifications of present-day fertilizer practice, owing to their physical condition.

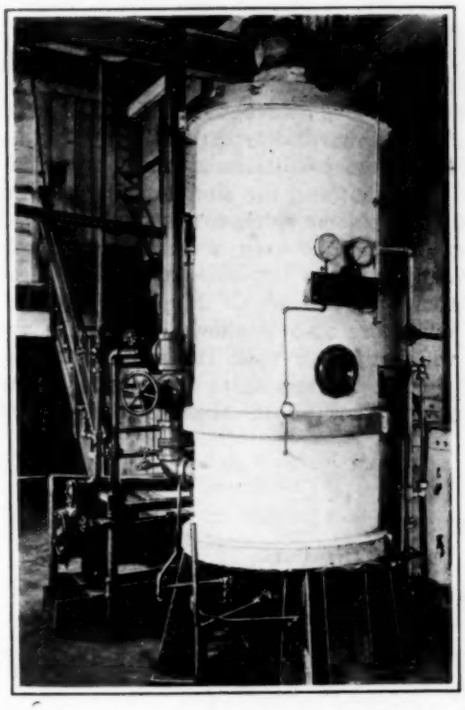


Fig. 5—Evaporator Unit for Concentration of Urea Solution
This single-effect, vertical tube evaporator is constructed of aluminum. The vacuum pump may be seen in the rear.

From this and other work more recently published it seems safe to conclude that practically all kinds of plants can be satisfactorily supplied with nitrogen in the form of urea. A wide agricultural use of urea seems to await only a cost sufficiently low together with an adequate supply.

The experimental work at Niagara Falls confirms the earlier estimates of the cost of making urea in a plant like that owned by the Government at Muscle Shoals. Considering the feasibility of making urea there in Nitrate Plant No. 2, F. M. Becket of the Union Carbide Co. testified before the Senate Committee on Agriculture early in May, 1924. He then estimated that "urea can be produced at $44 per ton of 20 per cent nitrogen fertilizer, and would therefore cost the American farmer only two-thirds of what he now pays for Chile nitrate, and in addition would save five-eighths of the freight now paid, if shipped in the concentrated form, containing over 42 per cent nitrogen." It is stated that the Niagara results do not necessitate any increase in the above estimate.

It should be understood that the above estimate contemplated operation at Muscle Shoals with only the capital charges implied by the payment of a proposed rental for the government plant to be so used. The cost estimate did, however, include payment for the power needed together with all other manufacturing expenses. No selling expense or profit was included, but it appears that the margin between $44 and the current price of

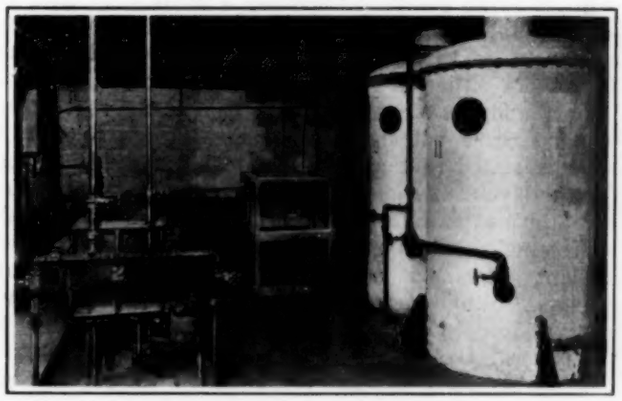


Fig. 4—Hydrolysis and Filter Unit for Second Stage of Process
The two hydrolysis tanks, appropriately insulated, are at the right. The filter, it will be noted, is a conventional plate-and-frame type.

ammonium sulphate is sufficiently wide to justify an expectation of successful commercial operation of a urea plant under conditions existent at Muscle Shoals. It is upon that basis of estimate that the Union Carbide Co. has made its several proposals to the Government for use of the Muscle Shoals property.

The upper limit of nitrogen content in any nitrogenous fertilizer materials now available in quantity is about 20 per cent. This percentage is reached only by ammonium sulphate. Chile nitrate and most of the other materials contain less and even the "concentrated" fertilizer materials which are proposed for future use, such as mono-ammonium phosphate, have a lower nitrogen content than ammonium sulphate. The mono-ammonium phosphate must be used instead of the diammonium or triammonium salts which are very hygroscopic. Apparently, therefore, urea and ammonium nitrate are the only nitrogen carriers which can be used for boosting the nitrogen content of mixed fertilizers to higher percentages than have already been reached in the most concentrated fertilizer materials available. Ammonium nitrate is objectionable as a nitrogen booster because of its very hygroscopic nature. Urea apparently offers, therefore, a greater economic service in making high nitrogen fertilizers available than does any other prospective fertilizer material.

With the tremendous advantage in saving of freight which a satisfactory fertilizer of high concentration would afford, the economic service to the farmer is of great importance. It is evident, therefore, why all who are interested in the betterment of agriculture hope that this valuable fertilizing compound may soon be manufactured on a significant industrial scale.

Layout and Design of Chemical Plants On a Philosophical Basis

Notes on a Method of Developing Plants in a Rational Manner Which Results in the Nearest Possible Approach to the Ideal

By Crosby Field
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THERE is a philosophy applicable to the growth of every plant. Frequently a plant is so built as to force it away from the philosophy underlying its layout, so this statement must be modified to read that there either is or should be a philosophy underlying the layout of every plant. That is one reason for terming these notes philosophical. In this respect it may be stated that a plan is not absolutely necessary for the layout of a plant, although one is always desirable; but a plan is specific, whereas a philosophy is more general. A plan will frequently need changing as a plant grows, but a philosophy should hold without change. In this connection the application of the underlying philosophy to any one specific plant may be called the general plan of that plant.

There should be guiding principles for the layout and growth of each plant and the study of these principles may well be called a philosophy, because a philosophy permits the establishment of an ideal, and a comparison therewith of the plan being studied. If we desire to revert to the usual meaning of the word, then we may include as a branch of philosophy the study of the place in which is combined commercial, physical, and chemical activities.

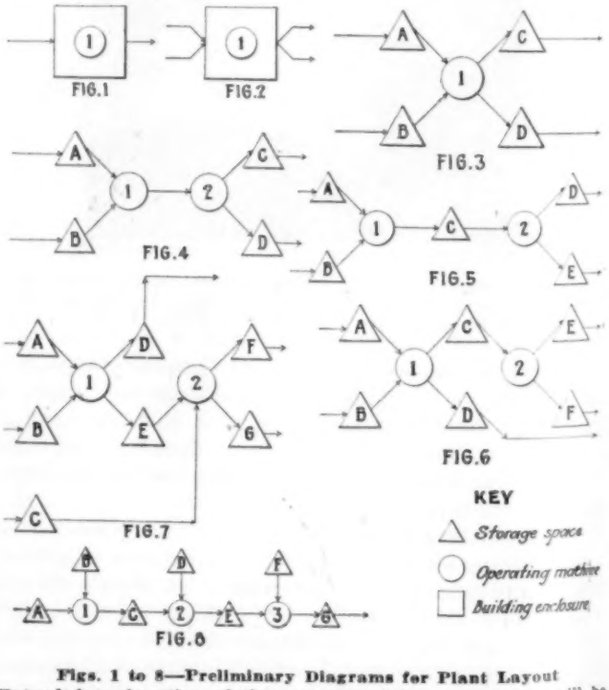
The term "plant" is preferable to the term "mill," "works," or other similar term because each of the latter terms does not of itself convey the idea of constant growth, and the fundamentals underlying the activities of a plant must always be stated with a view of constant growth in mind. A plant cannot stand still—it must either progress or deteriorate. If an endeavor is made to keep it in a constant condition it will be found that deterioration is sure to claim it. A plant in nature is constantly growing and in growing is constantly adapting itself to changing conditions. A manufacturing establishment of any kind must do likewise, hence the term "plant" is most appropriate for use in a study of the philosophy underlying its growth.

In daily life the plant may be considered as a sort of battleground where men and materials meet and struggle, the result being some saleable or otherwise useful product and much waste. A plant must provide essentially a place for the storage of materials, the conduct of the operations or processes, and the movement of the material to and from process and storage places.

In establishing a method for making plant layouts in this philosophical manner, it is helpful to apply schematic diagrams to illustrate the principles involved and upon these diagrams to build the plant design, even as a machine designer builds his functioning machine upon the skeleton of a kinematic diagram.

Fig. 1 is a schematic diagram of the simplest possible operation. It shows a single piece of production equipment or machine as it will hereinafter be termed, within a suitable enclosure, and the process is so carried on that a single material is brought from outside, dumped into this machine, and the finished product carried away immediately. In other words, there is no storage of raw material or finished product and the process is the simplest possible. Examples occur regularly in such work as drying, mixing and the simpler chemical transformations due to heat alone. It is plain that in such a case the simplest sort of shed with a machine inside is all that is necessary.

In Fig. 2 the problem is a little more complicated. Two materials are processed in the machine but no storage is provided and both the finished product and the waste are immediately carried away. It is obvious that under most conditions a plant must have some storage facilities; and the simplest operation, extended so as to include some storage, is shown in Fig. 3. Note how the inclusion of even a small amount of storage space vastly extends the building. This fact will be noted from time to time as this study progresses. In Fig. 4 one more step is shown, and there are 2 machines which operate upon the same material, so arranged that no storage space is necessary between the operations performed in them. It is very seldom



Figs. 1 to 8—Preliminary Diagrams for Plant Layout
Extended explanation of the meaning of these diagrams will be found in the accompanying text.

advantageous to operate in this fashion and as a result the two operations will be extended as in Fig. 5, wherein a storage space for semi-finished products "C" is included between machines 1 and 2. In most chemical plants, however, the product from machine 1 is in 2 parts, one of which can be immediately used or sold, and the other of which must undergo the operation in machine 2. In this case the plant takes on the general shape of Fig. 6. Most frequently, however, it is necessary in machine 2 to add something to the material from machine 1, and under these circumstances the plant takes the form of Fig. 7.

When it comes to a plant of 3 machines, however, it becomes very necessary to take the general arrangement shown in Fig. 8, wherein there is sufficient storage for the raw material "A" and the intermediates "C"

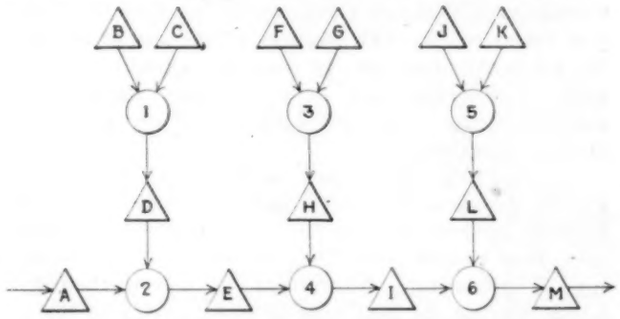


Fig. 9—A Diagram That Applies to Many Chemical Plants
This plant shows two well-defined directions of flow, materials processed in the sub-processing lines (vertical) joining the main process line at right angles

and "E" for machines 1, 2 and 3 respectively. Storage for the finished product "G" is also provided in our typical chemical plant. However, it is rarely the case that raw material such as "B," "D" and "F" of Fig. 8 can be added directly to their machines, but instead must undergo some preliminary processing, and the consequence is a plant form such as Fig. 9, wherein two well defined lines of flow for material are apparent, one the main production from "A" to machine 2, to storage "E" to machine 4, to storage "I" to machine 6, to storage of finished products "M"; and another flow at right angles to it consisting of several groups, as raw materials from storages "B" and "C" processed in machine 1, then stored in "D" before entering machine 2, also raw materials from "F" and "G" processed in 3 then stored in "H" before entering machine 4, and finally raw materials from "J" and "K" processed in 5, stored in "L" and then going to machine 6.

Not only is Fig. 9 typical of processes in a great many chemical plants but also of a great many other operations such as automobile assembly wherein the main frame travels in one direction and as it progresses subassemblies are attached to it, each subassembly receiving its components as it travels usually at right angles to the line of travel of the main production.

In chemical plants there appears a new phenomenon which must be taken care of—in nearly every reaction of the main product one or more byproducts of more or less value are obtained. It is necessary to take care of these and Fig. 10 shows a plant with the necessary storages "E," "F," "L," "M," "S" and "T" to accommodate them.

By this time not only is the addition of extra equipment difficult, but there is also an appreciable amount of space wasted due to there being no planned line of demarkation between the storage facilities and the manufacturing space, which results in duplication of space for each and an additional amount placed unsuitably for either. One method of tackling this problem is to have a main storage space for raw materials run roughly at right angles to the main line of process flow and a storage space for finished products parallel to this first storage but on the other side of the machines. This is shown in Fig. 11, wherein it will be noted that all the raw materials and intermediates have been allocated to the storage space *abcd*, the machines to the space *cdef*, and the finished products to the space *efgh*. Although the total space required by this layout is obviously less than the space required by the previous figure, there are two decided disadvantages in the scheme. First is the difficulty of installing additional equipment should increased production be desired, and second, the storage spaces cannot be used interchangeably.

There are many advantages in being able to conveniently use the same storage space for finished products as for raw materials. Such cases will come to the mind of every plant operator, but in general are due to rail difficulties, sudden decreases in orders, or other temporary cessation or sudden lessening of shipments, causing the plant to store a larger amount of finished product while it may perhaps not receive its full quota of raw material. Under such conditions if the plant is to be kept going it is necessary to use up the raw material on hand and take the space thus released for storage of finished products. It should be noted in this respect that it is not easy to add equipment by simply

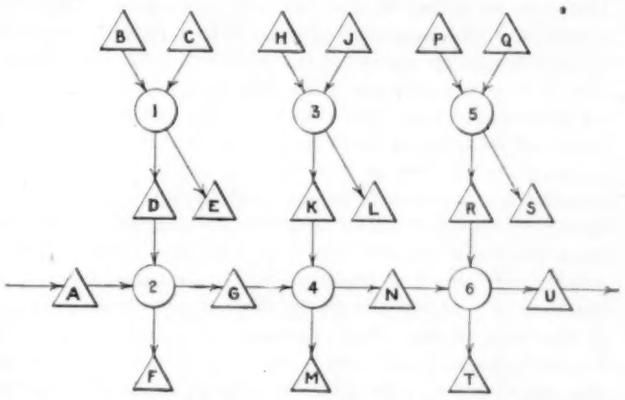


Fig. 10—An Adaptation of Fig. 9 for Some Chemical Plants
This diagram provides for the storage of byproducts formed in processing the main products

utilizing the space *efgh*, because it is usually preferable to have two machines doing the same work placed side by side rather than one in front of the other when looking along the line of flow; and, if the maximum economy of plants is to be achieved it is desirable to reduce the capital invested, particularly for property used only indirectly in production, and this can be accomplished by making a distinction between types of building for manufacture and for storage.

These changes are taken care of in the layout shown in Fig. 12, in which there is one storage space and one manufacturing space, each capable of extension in at least two directions without conflict with each other. It will be noted that all raw materials are stored in *abcd* and the manufacturing equipment placed in *cdef*. The raw materials are stored most conveniently near their machine, as shown, "B" and "C" for machine 1, "A" for machine 2, "H" and "J" for machine 3, "G" for

machine 4, "P" and "Q" for machine 5, and "R" for machine 6. Also, the intermediate material "D" made in machine 1 is stored with the raw materials and nearest to machine 2 where it is to be used. Similarly "K" made in 2 for use in 4 and "N" made in 4 for use in 6 are each stored near the machine in which they are to be used. It is assumed in making this sketch

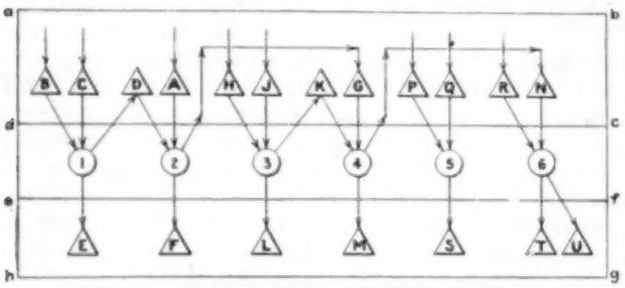


Fig. 11—Diagram Suggesting Arrangement of Building for Case Shown in Fig. 10

This separates the storage for raw and finished materials, the manufacturing building intervening, and hence being restricted in growth.

that each machine produces some product to be sold without further processing and storage space for these products is shown at "E," "F," "L," "M," "S," "T" and "U" respectively.

It is evident that, should it be necessary to increase the production from this plant, all that need be done is to install the machines shown in *efgh*, an extension to the manufacturing department. In this connection, however, experience in manufacturing plants shows that due to either fluctuations in demand or improvements in manufacturing processes, it is rarely necessary to increase in its entirety any existing individual plant; but it is often necessary to add more equipment of a certain type where the "neck of the bottle" is found. It would be difficult to arrange for this in the previous layouts, but in that in Fig. 12 it is easily accomplished; and the layout then becomes that shown in Fig. 13, in which is shown a plant wherein 3 machines similar to machine 1 are needed and 2 of the type of machine 2 are needed, also 2 of machine 3, 1 of machine 4 and 3 of machine 5. It should be further noted that although in the case of the single machine it would probably be desirable to add additional manufacturing spaces *efgh* and *ghjk*, yet if this general plan is adopted, wherein the machines involved are of an extremely large size, then these areas may be divided up again into sections by means of lanes or walls at right angles to those above noted so that the entire area becomes divided into squares. The final shape will give a storage space *abcd*, and a manufacturing outline *cdjlmnpqrkc*. This will give the outline of the buildings or groups of buildings necessary. At any later time, when occasion arises, it is possible to build up the space *mnpqrl* and to extend the fronts *jk*, *aj*, *bk*, or *ab*.

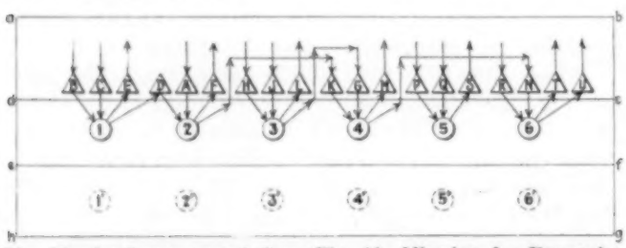


Fig. 12—An Improvement Over Fig. 11, Allowing for Expansion

Here the storage is concentrated on one side of the manufacturing building and hence both departments are free to expand in several directions.

Having made the series of "kinematic" diagrams upon which to base plant growth, (Figs. 1 to 13 inclusive), it becomes possible to apply these fundamentals of the philosophy of plant layout. Many more or less simple applications at once come to mind, but in order to make a real test let us apply this philosophy to a plant of large size making a great variety of products by many different processes requiring a miscellany of equipment including a large number of buildings.

In applying the diagrams, which means simply extending Fig. 13, a starting point is necessary. The best location to select for an operation of this size is a riverbank, along which docks and rail spurs can be built, which will supply water to the plant, and which at a downstream point will take the effluent.

Applying the diagram, Fig. 13, first to the land, a storage area *abcd* and a manufacturing area *dcue* can be laid out as in Fig. 14. Because of the size of the plant, the kinematic diagram can next be applied to the buildings, considering each as a machine, since, from a manufacturing viewpoint each comprises a group of similar machines.

In order to get the maximum use of the storage space, and at the same time have each raw material or intermediate nearest its point of consumption, the storage area *abcd* should be entirely covered by a single building of dimensions determined by the method given below, having its long axis at right angles to the axes

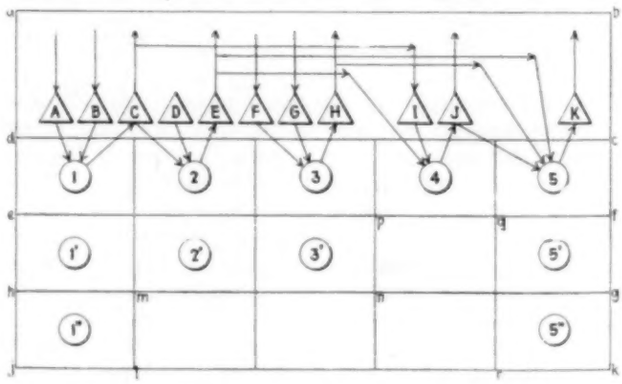


Fig. 13—A Special Case of the Diagram in Fig. 12

This allows for expansion in some departments, where needed, for few plants expand evenly throughout.

of the manufacturing (or, more strictly, operating) buildings.

The three factors necessary for the general plan of any plant are, first, a starting point or location; second, a kinematic diagram or directional factor; and third, a statement of the amount of space needed for the various storages and operations, which we may call the "quantitative factor." Combining these gives the "vector" diagram upon which to base the plant layout.

From known or estimated amounts of space it is possible, therefore, to obtain the proper allocations and subsequently the area of each building required. The operating buildings should be suitable to the operations carried on within them, of convenient width and as long as is necessary to give the needed area. The storage building should be as long as is necessary to extend the full width of all the other buildings and the spaces between them and wide enough to give the required area. Fig. 14 shows four operating buildings, *defg*, *hjkl*, *mpqr* and *stuc*, with sufficient space for light and passage between them as shown by the spaces *fghj*, *klmp* and *qrst*.

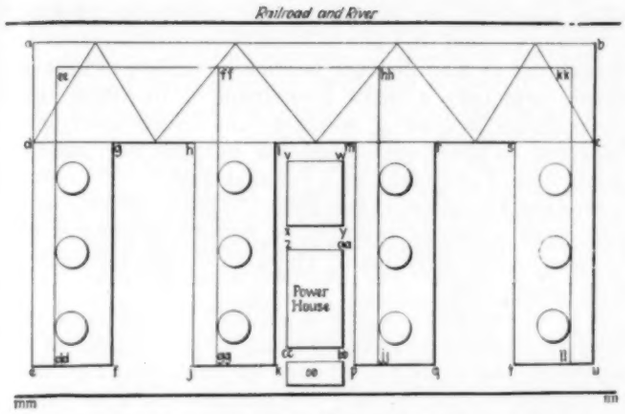


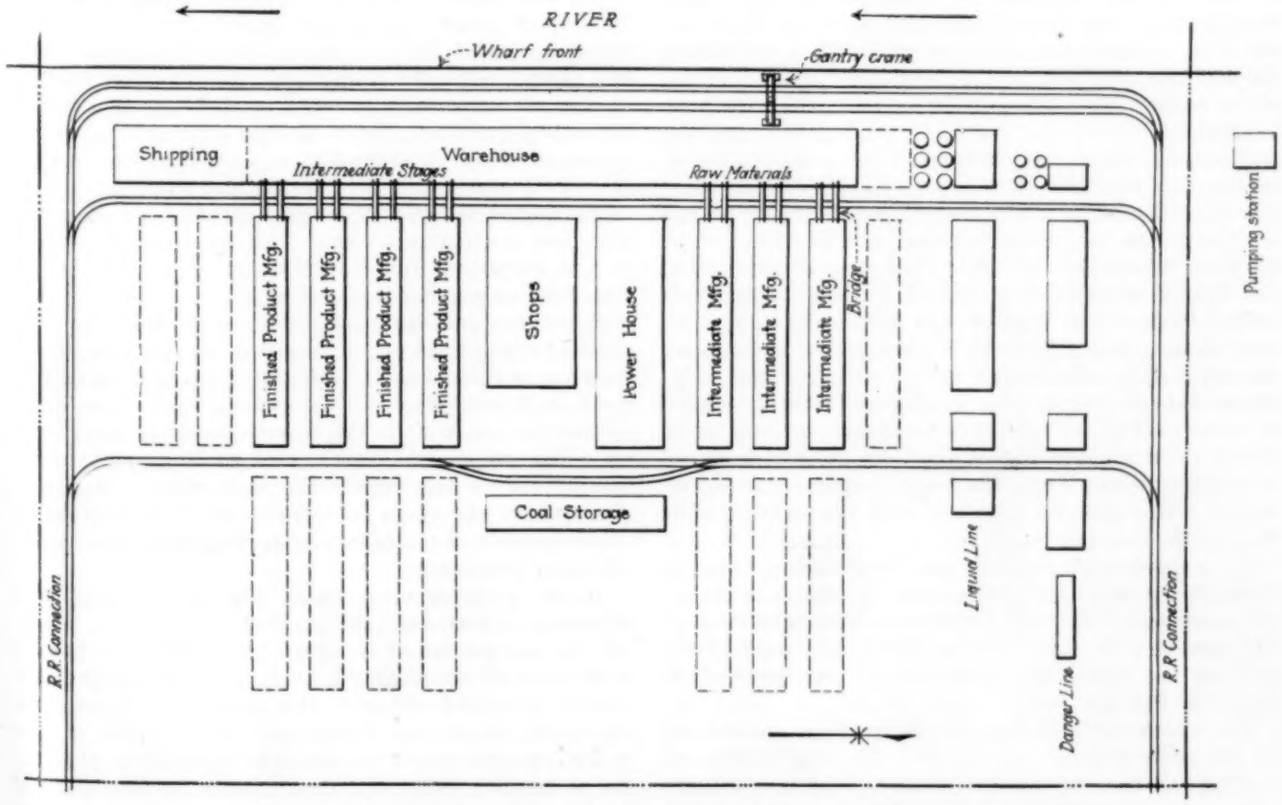
Fig. 14—Principles of the Preceding Figures Applied Diagrammatically to an Actual Case

Here the actual outlines of the buildings and the lines of transportation for materials appear.

These buildings may be of any height or floor levels desired, but it should be noted that great economies may be effected in multi-story buildings by concentrating in the storage building all elevating machinery, particularly that used for several products, and arranging for horizontal conveying to and from the operating buildings on 2 one way levels, on the top story from storage to operating building by way of a bridge at that level, the return on the ground floor. All vertical movement of material being processed in operating buildings is downward, via chutes, pipes and the like. The intermediate materials may be stored in the storage building at any level, but are brought to the top story for transportation to any building for processing. This permits a full utilization and easy control of all elevating equipment and will be found to cut down very materially the initial installation cost as well as the operating expense of the elevators and also the irritations and expenses incident on their breakdown. The warehouse itself should be provided with the most suitable horizontal conveying apparatus, which can be better afforded because of the high utilization factor of such equipment. Conveyors in the warehouse are indicated by line *ee-kk* and those connecting to the operating buildings by *ee-dd*, *ff-gg*, *hh-jj*, and *kk-ll*.

Let us assume a product, (C), made in the group of machines No. 1 of Fig. 13 which are located in building *defg* of Fig. 14, using raw materials "A" and "B." Assume further that machines 1 can best be worked on three levels, so that the building has three stories. "A" is stored on the ground floor of *abcd* because of its weight and bulk, whereas "B" is stored on the second floor. There is a bridge between warehouse and operating building at the third story. Because of considerations mentioned later, the transportation selected for this operation is electric industrial tractors and trailers. It then follows that the course traversed by the materials is: "A" is loaded on trailers on the ground floor, the trailers are pushed manually or by tractor to the elevator, carried by it to the third floor of the warehouse, thence by tractor over the bridge onto the third floor of *defg* and into the machines. Similarly, "B" is carried from the second floor to the third, over the bridge, and to the machines. "A" and "B," as materials in process, work down in the machines to the first floor, whence as "C" they are carried back to the warehouse and stored on any convenient floor, preferably where they are easy of access to the transportation system feeding "D" and "F" to machines 2 and 2′, considered as a group placed in building *hjkl*.

The remainder of the basic diagram of Fig. 13 can be applied to Fig. 14, remembering the concentration of transportation facilities in the warehouse.



Figs. 15—A Plant Layout Based on the Principles Brought Out in the Preceding Diagrams

There are two general classes of conveyors, which may be called the "continuous" and the "unit" or "batch." Selection of the proper class is one of the most difficult of problems, as a multiplicity of factors must be considered. One of the most frequent errors is the installation of a continuous conveyor where a much cheaper batch conveyor would have done as well, the result being only a few minutes daily use of the expensive continuous machine.

The following factors are most important in the selection of the proper conveying method:

1. Nature of the material being handled.
2. Quantity being handled per unit of working time per unit of distance conveyed, i.e., the traffic-density factor.
3. Nature of the loading location, e.g., the warehouse pile.
4. Nature of the destination location, e.g., the feed mechanism to the machines.
5. Vertical and horizontal components of the path travelled.
6. Number of branch paths travelled.

It is obvious that the nature of the material has a great influence upon the conveying system, as liquids can best be transported in pipes, corrosive liquids require special protective materials or devices for carriers, etc. The effect of the traffic-density factor is not at first so apparent, but in general it has only a certain range in which it does not require a change in the selection as first determined by the nature of the material. Thus, we always consider water as being transported in pipes, but where only a little is used per unit of time and the distance is great, we may use a tank wagon; that is, a change is made from a continuous to a batch system. Conversely, for a small production we may transport a solid material in batches, but when the production increases so that the number of batches becomes large, we may substitute a continuous conveyor.

After all the operating machines and buildings have been located, two very important services requiring buildings remain: the maintenance building containing the machine, carpenter, forge and other shops and the power house. The latter should be place as centrally as possible, as shown by *z-aa-bb-cc* in Fig. 14, and its services, all conveyed continuously in pipes or wires, arranged in the form of a large rectangle or loop passing along the edges of the operating buildings with the services to the individual buildings connected to two of the main headers of the loop. This permits the cutting out of any machine or group of machines with their power feeders for repairs and yet maintaining the services on either side thereof. Because of supervisory and other close contact with the power house, the maintenance shops can well be located adjacent, as shown in *vwyx* in Fig. 14. Where the traffic justifies it, an additional conveying line *mm-nn*, for taking machines and parts to and from the various units may be installed. This may be combined with the railroad spur feeding the coal pile *"oo."*

The extension of Figs. 13 and 14 to include what is undoubtedly one of the most complex problems of chemical manufacture existent today and the modification in the general plan (but not the philosophy) made desirable by the particular conditions of the problem, is shown in Fig. 15.

The warehouse and manufacturing areas are laid out on the same general plan as that followed in Fig. 14, multiplying the rails along the wharf and providing a gantry crane to take care of the large amount of material handled. In examining the materials involved, several are noted that are of themselves explosive, or in the process of manufacture become an explosive hazard. These form only a small proportion of the total, and consequently instead of designing the entire plant with reference to these explosives, the hazards are isolated at one end of the plant in a "danger line."

Another exception to the general plan is found. One very large group of products is liquid throughout the manufacturing operations. These have been segregated in a "liquid line."

A third exception occurs in the fact that most of the finished products require mixing. Great economies of apparatus and space are effected by concentrating these mixing operations and they are placed as an addition to the finished products section of the warehouse.

A final exception is the placing of the pumping station well up-stream to take advantage of the fresh, clean water supply.

All the other groups of equipment are laid out and housed as in Fig. 14. The raw material, arriving either by boat, train or truck is brought into the warehouse through the door most nearly directly opposite the building in which it is to be first used. It is stored in any convenient place, and then transported to the point of consumption by the selected conveying means. In the particular case assumed, batch movement of solids in industrial trucks is indicated. The raw material is then picked up by an industrial truck, with or without trailers and carried on an elevator to that upper story on the same level as its point of use in the operating building (normally the top story), whence it crosses the "north" (see Fig. 15) bridge to the operating building. The truck unloads at the machine, then continues on its way to the nearest cross gallery or cross aisle, where it crosses to the other side of the building and returns to the warehouse by the "south" bridge, thus providing "one way" traffic. Industrial trucks also pick up the finished product from the machines on the ground floor and carry it into the warehouse for temporary storage or for elevation and subsequent delivery to another operating building. This method of handling is repeated until the final product is carried to the "south" end of the warehouse for packing and shipping.

The industrial truck is supplemented where necessary by other conveying systems. All elevators are placed in the warehouse for concentration of vertical traffic, thus making maximum use of each.

Machinery and equipment are brought into the plant on the railway track on the "east" of the operating buildings and are lifted by the building crane and carried by it to position. Machinery requiring major repairs is carried by the crane in the reverse direction and placed on a flat car on the "east" track to be carried to the maintenance shops, where the shop crane unloads it. The yard of the shops provides storage for such major repair parts and machinery replacements as are needed with any frequency.

In the problem upon which Fig. 15 is based, this scheme requires half the ground area of any other, affords a minimum of handling and utilizes mechanical means for all handling. Extension of operating buildings is provided either to the "south" or "north" by extension of the warehouse and the addition of new buildings as shown in the figure by the broken outlines; or, if the new operating departments be closely allied to those already existing, additional building may be

added to the "east" of the present, across the track.

In a plant of this size, construction and repair activities are of no small magnitude. The scheme provides a free to and fro movement from the eastern track for materials connected with these activities and such movement conflicts in no way with the free movement of production materials to and fro from the western track.

The power plant and maintenance shops are centrally located, as was brought out in the discussion of Fig. 14.

A consideration of the facts brought out above confirms the statements made at the beginning of these notes. There is a philosophy underlying the growth of each industrial plant. The specific application of this philosophy to the problem in hand should result in an "ideal" general plan. This ideal plan may have to be modified many times as conditions change without in any way modifying the philosophy underlying it and of which it is a part. The ideal general plan can best be outlined by first making a schematic diagram showing the relation of all storage and manufacturing operations and the materials concerned therewith and then clothing this diagram. This schematic diagram underlying the general plan is similar to the kinematic diagram underlying the general plan of a machine. The above assertions have been illustrated by application to a number of different plants, from a simple one to a very complex one.

Synthetic Motor Fuels From Coal

Bergius Hydrogenation Process, Methanol and Synthol Reviewed by Fieldner and Brown of Bureau of Mines

AS A CONTRIBUTION to the symposium on motor fuels and oil conservation held at the intersectional meeting of the American Chemical Society in New York, Sept. 30, 1925, A. C. Fieldner and Ralph L. Brown of the Pittsburgh station of the Bureau of Mines discussed the status of the known methods for the complete utilization of coal. In addition to the high and low temperature carbonization processes, the paper described the hydrogenation of coal by the Bergius process as well as the high pressure synthesis of methanol and synthol.

The partial liquefaction of coal by hydrogen under pressure, according to the Bergius method, has been under laboratory investigation in a number of European laboratories, and a 2-ton-per-day unit operated by Dr. Bergius at Rheinau near Mannheim, Germany, was visited by Dr. Fieldner 12 months ago. It deserves serious consideration since it converts from 25 to 50 per cent of the coal into tar and oils, the yield varying with the type of coal and the conditions of hydrogenation.

In this process pulverized coal mixed with oil or tar to form a thick paste is heated at 400 deg. to 450 deg. C. in an atmosphere of hydrogen under a pressure of 150 to 200 atmospheres. Under these conditions the coal is converted into a black, tarry liquid which, on distillation up to 300 deg. C. yields oils and tar to the extent of 20 to 40 per cent, according to various reports, No reliable information is available on exact yields or what proportion of this tar can be refined into motor fuel distilling under 150 deg. C. Kling reports 15 per cent. Dr. Fieldner who visited the plant at Rheinau a year ago was told that 20 per cent of the coal was converted into neutral oils boiling below 230 deg. C. and 10 to 15 per cent below 200 deg. C. On the basis of 230-deg. C. end point gasoline, one ton of coal would yield 50 gallons. It is claimed that retreatment of the heavier oil increases the yield of lower boiling constituents. Other investigators, notably Shatwell and Graham in England and Fischer and Frey in Germany, have confirmed the essential facts of the Bergius process. Fischer and Frey, working at 75-100 atmosphere at 425-450 deg. C., converted semi-coke from brown coal into oils and gas in 45.2 per cent and 30 per cent yields, respectively.

We may therefore regard the Bergius process as one of the possible future methods for making a petroleum substitute from coal. But it must be emphasized that in this process a gasoline substitute is only one of the products, the gasoline being in about the same proportion as in a light crude petroleum. From the standpoint of motor fuel production the direct synthesis from gases seems more economical.

The investigations of Patart and Audibert in France and of Fischer and the Badische Anilin and Soda-Fabriken in Germany, together with the production of methanol from carbon monoxide and hydrogen on a commercial scale by the latter has put a totally new outlook on the entire subject of our future fuel supply. In this process, pure methanol is produced from two volumes of hydrogen to one of carbon monoxide when subjected to pressures of 150 to 250 atmospheres and temperatures of from 300 deg. to 425 deg. C. in a copper-lined reaction chamber, containing one or more of a number of catalysts which include zinc oxide or oxides of chromium, vanadium, manganese, tungsten, uranium, lead and bismuth. The cost reported from both French and German sources varies from 18 to 27 cents per gallon. About 18 per cent of the heat value of the constituent gases is consumed in the conversion. There are no by-products. On a volume basis the net or low heating value of pure methyl alcohol is about 60 per cent of that of gasoline. Ricardo has shown that the indicated thermal efficiency at the highest useful compression for methanol is 35.0 per cent as compared to 31.4 per cent for gasoline at its highest compression—the compression ratios being 5.2 for methanol and 5.0 for gasoline. It should therefore require 1.5 to 1.6 gallons of methanol to be the fuel equivalent of 1 gallon of gasoline. One ton of coke should yield 350 gallons of methanol.

However, we need not confine ourselves to methanol, the experiments of Franz Fischer, director of the Institute for Coal Research at Mulheim-Ruhr, show that fuel mixtures of higher heating value can also be synthesized from carbon monoxide and hydrogen. Fischer and his associates have produced on a laboratory scale from water gas a mixture which they term "synthol" that consists of a mixture of alcohols, aldehydes and ketones with small quantities of hydrocarbons. Water gas plus hydrogen is subjected to a pressure of from 75 to 150 atmospheres at 400 deg. to 425 deg. C. in a steel reaction chamber containing a catalyst prepared from iron and a solution of sodium carbonate and consisting presumably of sodium ferrite. By-products of this reaction are carbon dioxide, methane and water. By recirculation of the gases about one-third of the original water gas is converted into liquid products, having a distillation range similar to gasoline and a heating value of 8,200 calories per kilogram. This process is yet in its early laboratory stages, but promises further developments.

Utilizing Carbide Residue

Tests Show that Carbide Lime Is Suitable for the Pulp, Sugar and Building Industries

By J. J. Murphy
The Prest-O-Lite Company, Inc.

FROM the time acetylene was first produced on a commercial scale until very recently, the question of disposing of the carbide residue has never been studied carefully. Heretofore, all acetylene-producing plants were directing their efforts toward producing high-quality gas at a low cost, and moreover, in the early days, the price of commercial lime was so low that it would not pay to use carbide residue because of the high cost of handling. Acetylene manufacturers actually purchased property on which to dump this material, increasing the original investment in property appreciably. In addition, there was the added cost of thickening this sludge from the generator, as it had a water content of over 90 per cent. It is necessary to remove much of this water in order to store the material economically.

Today there are approximately 1,000,000 tons of carbide residue the consistency of stiff putty and containing about 50 per cent water, available throughout the country. At present, the annual production is about 300,000 tons, and is increasing each year. This material is a good high-calcium lime thoroughly slaked and aged, of exceptional fineness and high plasticity. It is estimated that the available lime putty now lying at the various acetylene plants throughout the country is worth approximately $1,750,000, as it lies on the ground. During recent years the annual production of hydrated lime from the generation of acetylene has probably been 150,000 tons, weighed dry. This is approximately 3.6 per cent of the total lime used in the country. As production is spread over the entire United States, introduction of this material into the lime market cannot be of sufficient importance in any one locality to compete seriously with the sale of ordinary commercial lime.

Lime sold in the United States in 1923, as recorded by the Geological Survey, Department of Interior, was 4,069,830 short tons, worth $39,937,707, an increase of 12 per cent in quantity and 20 per cent in value over 1922. Lime sold for construction work increased 15.5 per cent, that sold for chemical use 16 per cent, and that sold for liming land decreased 14 per cent. Hydrated lime, which is included in the total given, increased 10 per cent. The amount of hydrated lime consumed during the year 1923 increased 10 per cent over the amount used in 1922 and a price increase of 11.5 per cent. This was due to the many advantages of hydrated lime over burnt lime, such as the type of containers required, the fire hazard, and the tendency to slake in air. If the consumption and price of hydrated lime continues to increase, it will not be long before lime from calcium carbide can be dried and bagged at the larger acetylene plants and delivered to the market where more favorable prices can be obtained than locally.

After a thorough investigation, it has been shown that with the exception of exceedingly large accumulations, or a production of at least 25 tons of dry lime per day, it would be uneconomical to dry the material. However, in places where there is production of over 125 tons per month, on a dry basis, a filtration plant is a profitable investment. With such equipment, lime can quickly be put in condition for transportation within a radius of 75 miles without much investment in storage space. Otherwise the material should be disposed of locally in the wet state, that is, having a moisture content of about 52 per cent. At present, the best outlet is in the construction field.

In 1922, experiments were made at the Ohio State University to determine the suitability of this material in the manufacture of mortar for brick construction. These tests proved sufficiently satisfactory to warrant the use of carbide lime in the construction of new buildings, built for this University. Since that time, over 300 new brick buildings have been erected in Columbus, Ohio, in the construction of which carbide lime was used. Recent inspection shows the material to be of very good quality and durability. In May 1923, experiments were carried out at the Massachusetts Institute of Technology in the use of carbide lime for brick mortar and plaster. In summing up the conclusions of these tests it was reported that carbide lime mixes easier and feels more workable than commercial lime. Due to its high plasticity it has a better sand carrying capacity and it shows a greater strength in compression with a lean mixture, as used. It was also found that the sole disadvantage is the bluish-gray color in a wet condition, but upon drying, this color almost entirely disappears.

In the chemical field one of the most important uses of lime is in the paper pulp industry. One paper pulp mill in Maryland, operating on the soda process, has been using successfully thousands of pounds of carbide lime for causticizing soda liquors used in the digestion of the wood pulp. Experiments have been undertaken in a Canadian mill to determine the suitability of carbide lime for making chlorine bleach liquor in the manufacture of paper pulp. These showed that the liquor produced was of a slightly better color and of just as good a chlorine concentration as liquor from a high-grade burnt lime.

In the purification of beet sugar it has been proved that carbide lime, especially because of its low magnesium content, is very suitable for the defecation process. In the cane sugar industry it was claimed that sufficient silica is present in carbide lime to coat the evaporator tubes, thus increasing the cost of evaporation. This would reduce savings from using carbide lime to the point where it would not warrant changing over from present practice. However, this is only a claim to be approved or disapproved by actual experiments.

Experiments recently carried out at the Massachusetts Institute of Technology under Professor H. W. Haywood, at the request of the Boston Building Department, showed that brick piers set up with lime mortar made from carbide residue shows a slightly better compressive strength after a 28-day set, than piers set up with mortar made from a standard high-grade lime. In the case of lime cement mortar, the results obtained from the use of carbide residue were a little better than when the standard lime was used.

From results of work that has been done to date there seems to be no reason why an economic saving of three-quarters of a million dollars cannot be realized by acetylene manufacturers throughout the country.

Extracts from paper read before International Acetylene Association.

Exposition Week Sets New Records for Chemical Activities

Technical Sessions on Motor Fuel and Rayon Feature Intersectional Meeting of A.C.S.; T.A.P.P.I. and Other Societies Contribute to Success of National Exhibit

Editorial Staff Report

CHEMICAL industry held the stage in New York City during the week September 28 to October 3. Naturally the Tenth National Exposition of the Chemical Industries—the first to be held in New York in two years—proved the center of this activity and its 300 exhibits, supplementary lectures and instructional courses attracted a record attendance from the industries. Important sessions of several scientific societies contributed to the interest of the technical men.

Notable among these gatherings was the 4-day intersectional meeting of the American Chemical Society in which 10 eastern sections joined with the metropolitan chapter in joint symposia on subjects of such broad industrial interest as motor fuel and rayon. The Technical Association of the Pulp and Paper Industry, the American Ceramic Society, the Chemical Equipment Association, and the U. S. Chemical Warfare Association also held well-attended meetings during the week and on the evening of October 1 joined with the other chemical organizations in the fourth Chemical Industry Banquet, which was held at the Hotel Roosevelt. On this occasion an audience of five hundred was addressed by United States Senator James W. Wadsworth and Lawrence F. Abbott, contributing editor of *The Outlook*.

Student Course Proves Popular

Unusual interest was shown in this year's student course at the Chemical Exposition on the fundamentals of chemical engineering and industrial chemical practice. The total registration was between 135 and 140, of which 110 were college men. W. T. Read, head of the department of chemistry in Texas Technological College, reported an average daily attendance of more than 100, as against 75 during the 1923 program.

Several colleges allowed formal credit for attendance, Yale University leading, with a representation of 33 men and 1 professor. Case School of Applied Science sent 11 men and 1 professor, and Wheaton College marked a precedent for women's colleges by sending 2 students.

The course was confined to fundamentals of chemical technology and no attempt was made by any of the lecturers to develop specific sales propaganda. Separation of the students into two groups, elementary and advanced, proved markedly successful. A lack of inclusive lantern slides on the major unit operation equipment somewhat lessened the effectiveness of instruction, but this is a feature that can be remedied at the next exposition, provided adequate support is obtained from manufacturers.

Dr. C. O. Johns of the Standard Oil Co. of New Jersey was chairman of the intersectional symposium on the conservation of petroleum which had been called to focus the attention of the chemist, the automotive engineer, and the fuel technologist on the common problems of motor fuel supply and demand.

In the opinion of the first speaker, K. G. Mackenzie, consulting chemist of the Texas Company, the future outlook for increased supplies of gasoline is disappointing from the standpoint of revolutionary technical discoveries or developments. "We cannot look forward," he said, "to the chemist making ten gallons where but one grows now. It is true individuals are still putting moth balls on the market with the claim that one or two added to 5 gal. of gasoline will increase mileage from 10 to 50 per cent, but we are dealing with a fuel and, although technical developments in the use of gasoline will undoubtedly very materially increase the efficiency to be obtained per gallon, continued and increased production must depend upon a continued and increased source of supply."

Dr. Mackenzie reviewed the world's oil resources, paying high tribute in that connection to the several conclusions contained in recent report of the American Petroleum Institute. (See book review on p. 814.) Of the world output of 12,409,854,000 bbl. of crude oil in 1924, the United States contributed 63.7 per cent. The greater prospects for increased foreign production, however, indicate a gradual decrease in this percentage.

Dr. N. E. Loomis, director of engineering division of the Standard Oil Co. of New Jersey, declared that any survey of our resources should not overlook our enormous shale deposits that promise an eventual solution of America's oil difficulties. Dr. B. T. Brooks asserted that shale oil will come when its development is justified by the price of gasoline. "I doubt, however," he added, "whether we shall ever live to see it."

Fuel Possibilities of Alcohol and Coal

The constantly recurring bogey of cheap alcohol as a solution for our gasoline problem was definitely set at rest in a forceful paper by M. C. Whitaker, vice-president of the U. S. Industrial Alcohol Co. "The position of alcohol in the scheme of motor fuels is now comparatively clear," he said, "in spite of the fact that the subject still forms the basis for an enormous number of verbal balloon ascensions." The technical problems have been solved by the chemical and automotive engineers so that the future of alcohol motor fuels is purely a question of economics. It involves the relations between the cost of alcohol and the cost of gasoline. The cost of alcohol is necessarily linked with the question of the cost and available supply of raw materials. As gasoline becomes scarce an economic balance is established between the price of gasoline, the price of alcohol and the price and resultant supply of raw materials.

The chemical engineer, according to Dr. Whitaker, is ready to deposit the "fuel alcohol baby upon the

door-step of the economist and social reformer with full confidence that his obligation has been well performed. There are no technical difficulties remaining either in the making of the alcohol or in the use of the fuels made therefrom. The problem is now solely one of suitable economic conditions and one of public will."

When asked if synthetic methanol might not offer a better solution, Dr. Whitaker declared he had returned from Europe with but little enthusiasm for the product in this use. It does not blend well with gasoline and when used alone its thermal value is so low as to require almost 2 gallons to do the work of one of gasoline.

Neither shale nor alcohol from vegetable matter can be counted on to carry the bulk of the burden of furnishing a future supply of motor fuel according to A. C. Fieldner, of the Bureau of Mines at Pittsburgh, who with Ralph L. Brown had prepared a paper on the complete utilization of coal. Three processes were advanced for obtaining motor fuel from coal: 1. Carbonization, including both the present byproduct coke method and low-temperature processes. 2. Hydrogenation of coal by the Bergius process. 3. Complete gasification of coal and conversion of the resulting gases by pressure into methanol, "synthol" and other liquid combustibles. Reference was also made to the work of Bury at the Skinningrove Iron Works in England who obtained an average yield of 1.6 gal. of ethyl alcohol from the ethylene contained in the coke-oven gas derived from each ton of coal carbonized. Further comment on the Bergius and synthol processes will be found on page 799 of this issue.

The future motor-fuel situation is intimately a part of the development of the gas industry and it is not too soon, Dr. Fieldner believes, for the technologists in the gas and petroleum industries to join hands in research that will pave the way for this development. This was heartily seconded by Dr. W. H. Fulweiler, chemical engineer, of the United Gas Improvement Co. and president of the American Society for Testing Materials.

Motor Design and Fuel Economy

The automobile of the future,—"mentally constructed to yield maximum possible mileage" was described in a paper prepared by Charles F. Kettering, president of the General Motors Research Corporation. This ideal car, which would have two high-compression motors (to be used for different load conditions), a carburetor with fixed adjustment, automatic spark advance, a disengaging transmission and other features of proved economy, would not be saleable because it lacked the most essential requisite, utility. In other words, "increased miles per gallon cannot be obtained at the expense of utility except through extreme change in the price of motor fuel. Increased efficiency can come only when it means both increased miles per gallon and increased utility."

The most hopeful possibility for economy through motor design lies in the development of the high compression motor. Mr. Kettering declared, however, that "higher compression must wait for a more nearly universal distribution of an anti-knock fuel. Such distribution is being rapidly extended although it cannot become universal nor solve the high-compression problem until certain difficulties that have been met are recognized as having been overcome."

Discussion of this paper by the research director of the Society of Automotive Engineers indicated that the automobile industry must look for fuel improvement to make possible any great gain in design and efficiency. It was incumbent upon the chemist to work more closely with the automotive engineer in the solution of this problem. It was also suggested that the use of heavier fuels than gasoline might be made possible by further improvements in the Diesel engine. Such power is already being applied experimentally in tractors and trucks and the outlook for further progress in this direction is distinctly hopeful.

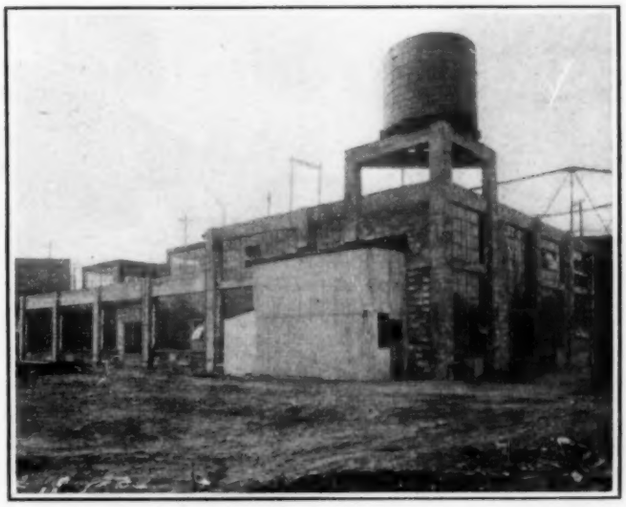
Rayon: Basis of An Enormous Industry

Recent growth of rayon manufacture, according to Dr. M. G. Luft, technical director of the Industrial Fibre Company, may reduce the production of cotton, stabilize its price and establish reasonable profits for the textile manufacturer. Rayon, he asserted, would not force either the cotton or silk merchant out of business but in the end would have a stabilizing influence. Since it is a synthetic product its output is not affected by labor or climatic conditions. The crop of rayon, he declared, is determined solely by chemical research and the organization of chemical production.

The new industry is advancing by leaps and bounds, for example, France is now producing six times as much rayon as two years ago. The United States accounts for 40 per cent of the world's output. "The growing domestic rayon industry," declared Dr. Luft, "makes this country entirely independent of imports, and being based on raw material and equipment of domestic production, it is an important item from the standpoint of national economy. Due to the perfection of chemical processes and high quality of product, the American industry is able to compete with the production of countries where labor is much cheaper."

The Technical Association of the Pulp and Paper Industry held a special meeting to hear a series of papers presented by manufacturers' representatives. The Dorr save-all, described by C. Leander of the Dorr Co., consists essentially of a number of settling tanks, one placed above the other. Stock in the paper mill white water is thickened and delivered from the bottom of the tank at a consistency of 0.8 to 1.0 per cent. Victor Hybinette of the Pusey & Jones Co. outlined the advantages of nickel-copper-tungsten alloys for sulphite mill screens in resisting acid fumes. Paper machine rolls having less than half the weight of bronze rolls of the same size are being developed. B. C. J. Beckwith of the Johns Manville Co. indicated that condensation of moisture on the roof of paper machine rooms may be prevented by the use of a proper hood over the machine, by adequate ventilation and by carefully constructed roof insulation. W. A. Taylor of the La Motte Chemical Co. described a method of technical control for engine sizing. By using an indicator suitable for the range of hydrogen-ion concentration anticipated in the beater contents, a very careful control of its acidity is made possible by means of single laboratory tests. R. W. MacGreggor of Ernest Scott & Co. made a plea for the substitution of modern steam raising boilers behind the rotary furnaces for the old cumbersome and expensive disk evaporators. The straight fire tube boiler, having large tubes is recommended. The steam raised in these boilers can be used in multiple effect evaporators to concentrate the black liquor at a rapid rate.

Factory Unit No. 1, American Nitrogen Products Company, La Grande, Wash.



Modern Plant of the Pacific Nitrogen Corporation, Seattle, Wash.

Making Sodium Nitrite by the Arc Process

Commercial Feasibility of Industry on Pacific Coast Demonstrated by Successful Operation at Plant of American Nitrogen Products Co.

By H. K. Benson

Professor of Chemical Engineering, University of Washington

THE fixation of nitrogen by the arc process has been developed in Europe with a total capacity production of 37,200 tons of nitrogen per annum. The chief product has been weak nitric acid, which is usually neutralized by lime to form calcium nitrate for fertilizer. Instead of lime, ammonia may be used for neutralization, resulting in ammonium nitrate for military requirements. Aside from the Bradley-Lovejoy process at Niagara and an experimental plant in North Carolina, the arc process had not attained commercial development in the United States until late in 1915, when the American Nitrogen Products Co., of Seattle, Wash., entered this field. A brief description of the enterprises of this company will be given in this article.

The first step taken in the establishment of the arc process was an investigation of the arc plants of Norway by the president of the American Nitrogen Products Company, C. F. Graff, who entered into a license arrangement with F. H. A. Wielgolaski for the use of arc furnaces patented by him. When Mr. Graff returned to America with some foreign experts, a small experimental plant was built adjacent to the hydroelectric generating station operated by the city of Tacoma at La Grande, Wash.

In this experimental laboratory a great deal of work and effort was exerted in developing a successful commercial apparatus. The patents which had been secured included nothing in the way of development work whatsoever, but represented merely paper patents, as such. As the type of furnaces was a new departure from those heretofore existing in Norway, or elsewhere, original research was necessary in order to commercialize the idea.

Furnace after furnace of various shapes and sizes, some upright, some horizontal, some U-shaped, were designed, developed and built in a more or less crude and hasty manner in this effort to get going. This work was carried on nearly continuously day and night. It must be remembered that the period was that of the Great War, and there was a pressing demand for sodium nitrite because of the cutting off of importations from Europe.

The detail that gave the most trouble was, perhaps, the electrodes where the two ends of the long, high-voltage electric arc played on the furnace. For this part various materials such as brass, copper, iron, steel, etc., were tried. It was finally found that ordinary iron piping, jacketed and water-cooled, functioned as well, or better, than anything else, and this is what is used by the company in present furnaces.

This experimental work led to the design of a modified arc furnace, which was deemed satisfactory for operation on a commercial scale, and resulted in the construction of Plant Unit No. 1, with a capacity of one ton of sodium nitrite per day of 24 hours. This plant was put into operation early in 1917, and was used as a working model for the development of manufacturing processes and methods of plant control. This early experimental and constructive work was in direct charge of H. E. Ketchum, an engineer and co-worker of Mr. Graff in the Graff Construction Company. A technical staff was also selected from the faculty of the University of Washington, consisting of Professors E. A. Loew and C. E. Magnusson in charge of electrical research and the writer in charge of chemical control.

With the successful development of arc furnace operation and of the chemical processes, steps were taken for the design of Plant No. 2, with a capacity of three tons a day and embodying many improvements suggested by the operation of Unit 1. This plant was put into operation early in 1918, and has since been

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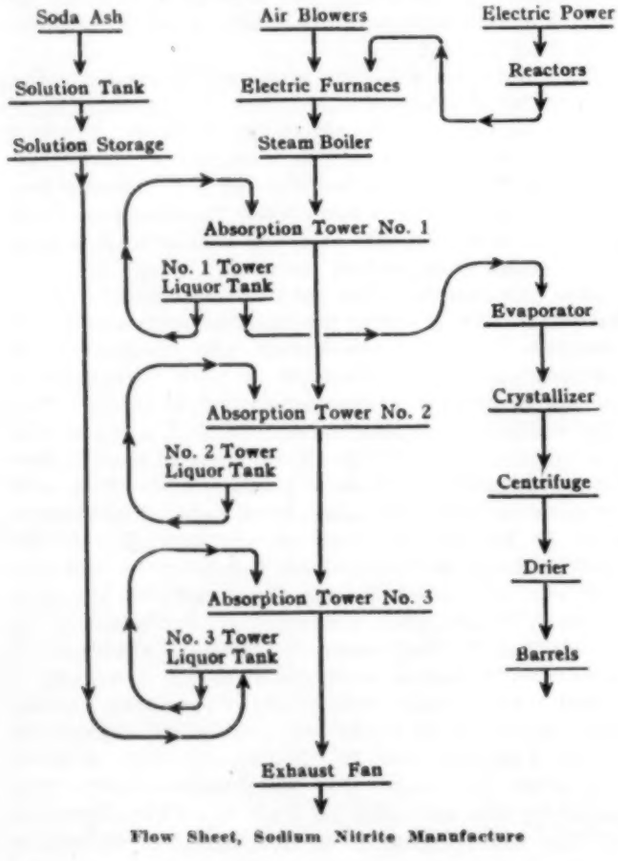
Headwaters of the Electron River, Harnessed by the Puget Sound Light and Power Company

enlarged to a greater capacity. In the later development of Unit 2, Prof. F. K. Kirsten, of the electrical engineering department, and Prof. W. L. Beuschlein, of the chemical engineering department of the University of Washington, took prominent parts.

The various operations in the manufacture of sodium nitrite by the arc method are indicated in the flow sheet shown herewith.

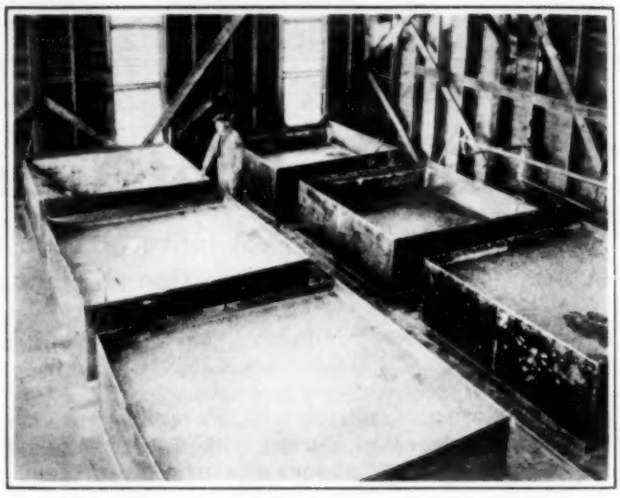
The furnace is made of three concrete tubes, giving an inner tubular space, within which the arc plays, and two annular spaces, through which the entering air passes in series. Thence the air passes through ports, spirally distorting the arc where the reaction occurs.

For the cooling of the gases, the ordinary fire tube water boiler is used. After cooling, these gases are conducted in iron pipes directly to the absorption towers. The latter are of wood stave construction, lined with brick, set in portland cement and filled with the usual type of filler, a webbed tile made by a local ceramic concern. At the base of each tower is a tank containing a solution of soda ash, which is pumped continuously to the top of the tower, distributed by splash plates over the tower fillers. As this liquor descends in a thin film it comes in contact with the ascending gases and the chemical reaction resulting in the formation of sodium nitrite takes place.



Flow Sheet, Sodium Nitrite Manufacture

When the soda ash liquor has attained a nearly complete reaction, it is concentrated in an evaporator to a nearly saturated solution at its boiling point, and then is discharged into crystallizing tanks where the deposition of practically pure sodium nitrite takes place. The crystals of sodium nitrite are then centrifuged, dried in a rotary steam drier and packed in paper-lined barrels.



Crystallizing Pans, American Nitrogen Products Company, La Grande, Wash.

When air is passed through an arc the reaction $N_2 + O_2 \rightarrow 2NO$ takes place to the extent of 6 per cent by volume (See Report 2041, Nitrate Division, p. 134), but, due to the high temperature of the arc, the final equilibrium attained when the gases leave the furnace gives a nitric oxide content of slightly less than 2 per cent by volume. As cooling occurs in the steam boiler, a secondary reaction between the excess oxygen of the gas occurs: $4NO + O_2 \rightarrow 2N_2O_3$ and at the temperature of the exit gases this reaction is practically complete. When this gas comes in contact with an alkaline solution, it dissolves with the formation of sodium nitrite:

$$Na_2O_3 + H_2O = 2HNO_2$$

$$Na_2CO_3 + 2HNO_2 = 2NaNO_2 + H_2CO_3$$

It can readily be understood, however, that these ideal reactions cannot be obtained entirely, and secondary reactions result from the further oxidation of nitrogen trioxide to nitrogen tetroxide:

$$2N_2O_3 + O_2 = 4NO_2$$

and when this enters into solution and reacts with the alkali, sodium nitrate is formed in part:

$$N_2O_4 + Na_2CO_3 = NaNO_2 + NaNO_3 + CO_2$$

It is evident, therefore, that rigid control conditions must be maintained both in the degree of oxidation and in the crystallization process to produce technical sodium nitrite of prescribed purity.

Acknowledgment is made of the generous assistance of C. F. Graff in the preparation of this article.

Heating by Electricity in the Chemical Industries

Development of Electrical Heating, Its Theory and the Types of Resistors Used Are Discussed in This Paper, the First of Three on This Subject

By Robert M. Keeney
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THE APPLICATION of electric heating to industry has passed through three broad stages of development during the past thirty-five years: (1) electric smelting, (2) electric melting and (3) industrial electric heating. From 1890 to 1900 electric heat was used almost solely in the manufacture of calcium carbide, in the smelting of ores to produce ferro-alloys, and in the electrolytic reduction of aluminum oxide to aluminum, all of which may be classed as smelting processes which can only be conducted satisfactorily in an electric furnace.

In 1900 the second stage of development began with the invention of the Heroult electric steel furnace—the prototype of all successful steel melting furnaces—and progressed gradually until 1915, when war requirements caused a tremendous increase in the use of the electric melting furnace in the steel industry and in foundries. Simultaneously at this time electricity was used in melting brass and non-ferrous metals, and will probably in a few years largely supersede combustion methods of melting these metals.

We are now in the third stage of the application of electric heating—industrial electric heating; which, as at present construed, due to temperature limitations of existing furnaces, is mainly resistance heating up to a temperature of about 1,850 deg. F. Its development really began about 1912 with the construction of the granular carbon resistor furnace by Baily, who was the pioneer investigator of the electric heat treating of iron and steel. It was not until about 1915, that the possibility of using nickel-chromium alloys as resistors for industrial heating devices or for heating large electric furnaces was realized. Although these alloys were patented in 1904, up to that time they had been considered suitable only for thermocouples, the windings of small laboratory furnaces, and domestic appliances. The idea of employing a metallic resistor in a large way was considered impractical. Undoubtedly the successful construction of large electric furnaces heated by granular carbon resistors was the catalytic agent which put the best brains of the electrical world to work on the application of the metallic resistor to industrial heating.

Progress in the application of electric heat to industries has proceeded in an entirely logical manner in conformance with the requirements of the industrial progress of the world. Its development has been from high-temperature processes which can only be conducted in the arc furnace down through the whole range of metallurgical processes to simple drying and baking at low temperatures. In 1890 electric lighting did not appear to be the ultimate form of lighting. When calcium carbide was discovered, many believed it had a large future for illumination. Calcium carbide can be manufactured only in the high temperature electric furnace. As a result of researches of Moissan on the production of ferro-alloys in the electric furnace, scientists became more interested in the possibilities of alloy steels, using in their manufacture high-grade ferro-alloys which could only be made in electric smelting furnaces. The process of electrolytic reduction of aluminum from its oxide, discovered simultaneously by Hall and Heroult about 1889, could only be performed in a furnace using direct current. Here we have the first application of low-temperature industrial heating, in that the oxide bath and aluminum metal were kept molten by their resistance to the passage of the current. Thus up to 1900 all applications of electric heat had been made because no other form of heat could accomplish the desired results.

Electric melting of steel was a natural development following electric furnace manufacture of ferro-alloys. The highest grades of steel were made by the crucible process, in which the output per heat is small; very pure raw materials must be charged, as no refining takes place and because the crucible introduces carbon into the steel; and the process is expensive. The early advocates of the electric process considered it mainly as a substitute for the crucible process, because it was believed that heats of one to three tons of alloy steel equal to the best crucible steel in 100 lb. heats could be made in the electric furnace more cheaply. As a substitute for the crucible process its introduction in the United States lagged far behind European developments until 1915, when the heavy demand for steel gave a tremendous impetus to its use not only in the manufacture of tool steels but for steel castings. The electric process is gradually taking the place of the crucible process for manufacture of tool steel; and it has almost completely replaced the small Bessemer converter for production of steel castings, because steel scrap can be used instead of pig iron, while the operation of a small electric furnace can be much more readily controlled than that of a small converter, and in most cases the cost of steel in the ladle is lower. The introduction of electric melting in the foundry resulted in the universal use of acid linings for this class of work, as no refining is attempted. In the largest steel foundries the acid open-hearth process is used because of lower production costs.

Electric steel melting was developed initially because of the need for a process, other than simple melting, in which refining could be accomplished, and tool steel produced in larger heats with a reduction in operating costs. The war gave the big impetus to the process and broadened its field to the foundry industry. Electric

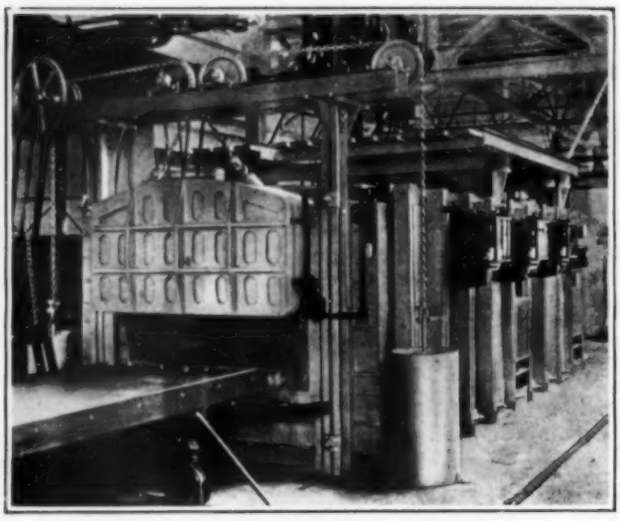


Fig. 1—330 Kw. Brass Annealing Furnace
This electric heating application results in less supervision, greater production, better working conditions, less labor turnover and less floor space.

heat was used in electric smelting to produce carbide, ferro-alloys and aluminum because the products desired could be made in large quantities in no other way. Electric heat was employed in steel melting because in the manufacture of tool steel and steel castings, in the specific plant in which the application was made, it showed a lower operating cost. It was not a necessary method of heating as it was in the first case. Thus electric smelting is a necessity, and electric steel melting is economical under suitable conditions for production of tool steel and steel castings. Temperature control had nothing to do with the adoption of electric heating in either case.

On the other hand, electric brass melting is rapidly replacing combustion melting of brass for one fundamental reason—temperature control. It is not, however, temperature control in the sense now used in industrial electric heating, i.e., control within plus or minus a few degrees, but is a limiting control of temperature. The first successful electric brass melting furnace used a carbon resistor. Previous to its introduction attempts made to melt yellow brass in an arc furnace either with or without a bath of slag had proven a failure, because of the high loss of zinc. A special type of induction furnace had been tried but difficulty in maintaining the lining was experienced. If electric brass melting could not give a higher metal recovery than combustion melting there appeared to be no great inducement for its use.

This was the status of the art in 1915 when Dr. Gillette of the U. S. Bureau of Mines made a detailed study of combustion melting of brass and proceeded to develop a rocking type of arc furnace for brass melting. The fundamental idea of this furnace was to prevent overheating by continual movement of the metal so that no part was exposed too long and overheated, and incidentally to secure longer life of linings. Development of the carbon resistor furnace, in which heat is reflected from the resistor to the roof and from the roof down to the charge, and development of the induction furnace proceeded at the same time, so that today there are three commercial types of electric brass melting furnace, all of which are designed so that there is limiting temperature control to prevent overheating and volatilization of zinc. Electric melting has saved thousands of dollars in zinc losses since the latter part of the war. Other economies have developed so that in a few years electric brass melting will be standard practice for plants of any size. Thus electric brass melting has reached its present stage because of temperature control.

Industrial Electric Heating

In the present commercial usage of the term, industrial electric heating is the application of electric heat for temperatures up to 1,850 deg. F. The temperature is limited by the life of nickel-chromium resistor alloys. Claims have been made that these alloys have a higher safe operating temperature, which may be true for small laboratory furnaces operated intermittently, but for large-scale industrial operation practice shows that the alloy should not be used at higher temperatures. Carbon, or graphite and silicon carbide, resistors will operate for a comparatively short period at temperatures of 2,500 deg. F.; but the upkeep is high and bothersome, so that the use of electric heat in this manner has not been extensive. Carbon resistor heating at temperatures around 2,000 deg. F. has proven successful for small forging work and rivet heating.

The early development of industrial electric heating with metallic resistors centered in the automobile industry, with the use of electric ovens for baking of japan. At the end of two or three years of progress, in 1919, there was an installed electric japanning-oven capacity of 30,000 kw. in the automobile industry. This industry at this time began to demand large production with a minimum of operating difficulties. Although gas and oil were cheaper on a fuel basis only, production was increased, labor and maintenance reduced, and the grade of product improved by electric heat so that the overall cost was lower.

With this successful application, industrial electric heating came to stay. Small heaters such as the space heater and cartridge heater were developed for miscellaneous industrial application simultaneously with the oven heater. Under the pressure of the production requirements of the war, electric heating using metallic resistors was first applied to large furnaces for the heat treatment of steel, thus raising the industrial application of nickel-chromium resistors from a tem-

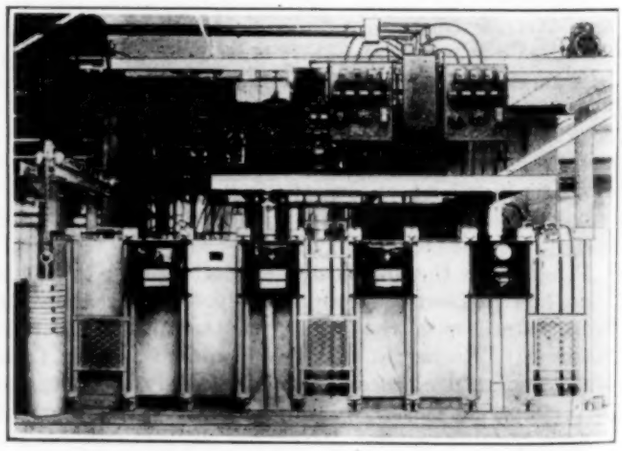


Fig. 2—330 Kw. Brass Annealing Furnace
This furnace is 16 ft. long, 4 ft. 6 in. wide and 18 in. high and is provided with recording pyrometer control panels on side shown, and with contactor panels above

TABLE I—COMPOSITION OF RESISTOR ALLOYS

Designation	NI Per Cent	CR Per Cent	FE Per Cent	MN Per Cent	SI Per Cent
1	65.1	11.18	22.36	0.70	0.26
1	61.8	13.4	21.86	1.76	0.22
C	64.68	12.7	21.02	1.16	0.26
C	61.45	10.43	24.16	3.74	0.15
3	82.7	14.4	1.95	0.70	0.24
3	82.36	15.9	0.84	0.48	0.16
A	79.85	18.22	0.76	0.92	0.08
A	77.1	19.7	0.98	1.72	0.29

perature limit of 500 deg. F. to 1,850 deg. F. At this time many heat-treating furnaces using the granular carbon resistor were constructed, but with the introduction of the metallic resistor furnaces to industrial heat treatment the carbon resistor furnace has lost ground because of the difficulty of controlling its temperature and of maintenance of the resistor.

Industrial electric heating has extended rapidly throughout industry largely because of the economies resulting from the possibility of close temperature control and because of its convenience. It is a clean form of heat. Electric heat has now passed through all of the stages usual in the development of an industrial fuel from its first use in electric smelting, because it was the only fuel with which the temperature required in the process could be obtained, and it is now used in simple heating because of its convenience and ease of temperature control. In a large measure the progress of electric heating has resulted from the increasing skill of the manufacturers of nickel-chromium alloys in producing reliable resistors in the form of wire and ribbon.

Nickel-Chromium Resistor Alloys

Nickel-chromium alloys have become the standard resistor material for electrical appliances, electrical oven heaters and industrial electric furnaces because of their high electrical resistivity, strength and resistance to oxidation at high temperatures. The composition of some of these alloys is given in Table I. Table II contains the properties of some rolled and drawn nickel-chromium alloys.

Theory of Electric Heating

The application of nickel-chromium alloys as resistors in electric heating is based on several laws applicable to direct current, as for practical purposes an alternating current in a resistor has a power factor of unity.

Ohms Law—$E = IR$

Where E = electromotive force in volts, I = current in amperes and R = resistance in ohms.

$$W = EI$$

Where W = watts

$$H = I^2Rt \times 0.0009478$$

Where t is the time in seconds and H is the heat in B.t.u.

One kilowatt-hour = 3,412 B.t.u.

To find the resistance R_t of a wire at any temperature

$$R_t = R_o\ (1 + xt)$$

Where R_t is the resistance at temperature t, R_o is the specific resistance, x is the temperature coefficient, and t is the difference in temperature between R_o and R_t. As temperature coefficients are generally given only from 20 deg. C. to 100 deg. C., for temperature over 100 deg. C., more accurate results can be obtained by use of Table 3. Calculation can be shortened by securing resistance tables from the manufacturer of the resistor material being used.

Although the design of a heating element involves no complicated engineering, in order to design a successful heater considerable practical experience should have been had before attempting the design of special heaters for a new application. Better results can be obtained by use of the standard heaters of manufacturers who have gone through all the experimental work necessary for the building of heating elements. In the construction of coils it has become common practice to use alloys of the grade containing 61 to 65 per cent nickel, 10 to 13 per cent chromium and 21 to 24 per cent iron for most industrial heaters to be used up to temperatures of 750 deg. F. to 1,000 deg. F. For temperatures over 1,000 deg. F., the 80 per cent nickel and 20 per cent chromium alloy should be used. The latter alloy differs from the former in being essentially a straight nickel-chromium alloy with iron present only as an impurity.

Applying Electric Heat

The application of electric heat to industrial processes should be dictated by common sense. Its goal is not to be the heating of everything from a house to a steel mill reheating furnace. The first question asked is what will it cost to operate with electric heat. The prospective user of electric heat usually thinks of the cost starting and ending with a comparison of power cost with fuel cost, and is astounded to find that on the basis of power versus fuel, electric heat is sometimes considerably more expensive. Dependent, of course, on local conditions, on a thermal unit basis, the power bill will usually be higher than the coal or oil bill, but will be either lower or not much higher than the gas bill, considering only artificial city gas. This general comparison also holds even when the considerably higher thermal efficiency of the electric furnace is given consideration, notwithstanding many articles disclosing figures to the contrary. Such a condition prevails in the majority of the industrial centers of the eastern United States.

There are, however, isolated cases where, due to local conditions such as comparatively cheap hydro-electric power, or expensive coal, electric heating is as cheap or cheaper on a B.t.u. basis than combustion heating. Localities where there is very cheap hydro-electric power will gradually disappear, however, with the increased demands of industry.

Most industrial plants operate ten hours per day so that in large industrial centers, the central station load is considerably lower at night than during the day.

TABLE II—PROPERTIES OF ROLLED AND DRAWN NICKEL CHROMIUM ALLOYS

	Specific Resistance at 20 Deg. Centigrade		Temperature Coefficient Per Deg. C. Between 20 Deg. C. to 100 Deg. C	Coefficient of Linear Expansion Per Deg. C. 20 Deg. C. to 100 Deg. C.	Approx. Melting Point Deg. C.	Maximum Working Temperature Deg. C.	Tensile Strength Pounds Per Square Inch (Annealed)	Specific Gravity	Weight Per Cubic Inch Pounds
	Microhms CMS	Ohms Per Circular Mil-Foot							
Designaton									
1	109.5	660.0	0.0002	1.25×10^{-6}	1,350	1,000	100,000	8.15	0.294
2	109.5	660.0	0.00015	1.30×10^{-6}	1,370	1,050	100,000	8.15	0.294
3	89.5	540.0	0.000187	1.32×10^{-6}	1,390	1,100	110,000	8.5	0.306
4	103.0	620.0	0.000179	1.32×10^{-6}	1,390	1,150	120,000	8.5	0.306

TABLE III—COMPARISON OF RESISTANCE WITH CHANGE IN TEMPERATURE FOR NICKEL CHROMIUM ALLOYS HAVING A RESISTANCE OF ONE OHM AT 20 DEG. C.

Resistance in Ohms for Various Temperatures—Degrees Centigrade

Designation	20 Deg. Ohms	100 Deg. Ohms	200 Deg. Ohms	300 Deg. Ohms	400 Deg. Ohms	500 Deg. Ohms	600 Deg. Ohms	700 Deg. Ohms	800 Deg. Ohms	900 Deg. Ohms	1000 Deg. Ohms
1	1.000	1.0185	1.0417	1.0645	1.0828	1.0928	1.0960	1.1022	1.1122	1.1257	1.423
2	1.000	1.0111	1.0242	1.0373	1.0508	1.0623	1.0595	1.0594	1.0630	1.0697	1.0781
3	1.000	1.0120	1.0265	1.0408	1.0555	1.0653	1.0657	1.0680	1.0760	1.0880	1.1033
4	1.000	1.0078	1.0170	1.0265	1.0360	1.0440	1.0373	1.0319	1.0334	1.0390	1.0482

Realizing the possibilities of increasing the night load with industrial heating, many central stations offer much reduced rates for off-peak operation. Many heating processes could be conducted at night as readily as during the day. Under these conditions electric heating on a power versus fuel basis, will usually prove less expensive than artificial gas heating, as cheap as oil heating, but more expensive than coal heating. The same results are obtained if the heating process can be operated 24 hours per day.

In the application of electric heating, overall plant operating costs must be the basis of arriving at final conclusions. Three characteristics of electric heat result in conditions which may give lower overall operating costs with electricity than with fuel, even if the power cost is higher than fuel cost:

(1) Temperature control of electric heat.
(2) Cleanliness of electric heat.
(3) Ease of delivery of electric heat at the point desired.

These three characteristics of electric heat generally result in the following conditions which tend to offset any higher cost for power than for fuel, which conditions are illustrated by the pictures shown herewith:

(1) Less supervision.
(2) Higher rate of production.
(3) Lower labor costs.
(4) Better grade of product.
(5) Fewer rejections.
(6) Lower labor turnover.
(7) Less fire and explosion risk.
(8) Better working conditions.
(9) Elimination of steam plant during summer.
(10) Saving in floor space.

Some Industrial Applications

In many cases these conditions put electric heating on such a basis that the overall plant operating cost is reduced by its use. A heat-treating process may require constant supervision with combustion heating. The installation of an electric furnace may reduce the supervision to a point that night operation is practical. Supervision has also been reduced by the ease with which electric heat can be applied to automatic furnaces. The elimination of supervision is often very desirable, not only for making night operation practical and with lower night power costs reducing the heat cost to a lower figure or figure comparable with combustion heating; but in permitting expensive supervision to be devoted to other matters.

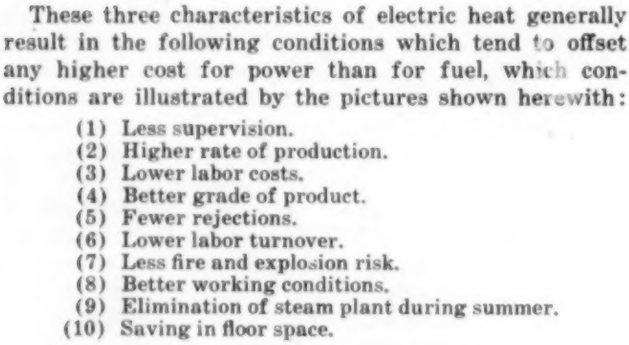


Fig. 3—Electric Barrel Heaters for a Cooperage
These heaters reduce the fire risk, give a better grade of product and reduce rejections for the barrel manufacturer

In the large factory any process which will increase production generally shows a large return on the investment. Electric baking of japan has proven over eight years of operation to be the cheapest way of baking japan in automobile factories. An electrically heated oven will generally turn out a bake in one-half the time of the same size gas oven operating with the same weight of charge. Today practically all automobile manufacturers use the electric oven in baking japan. Lower labor costs are the result of automatic temperature control, higher rate of production, and improved grade of product. The labor costs may be reduced by fewer men being required or by the possibility of the use of cheaper labor. Automatic temperature control has reduced labor costs in the baking of japan, bread baking and in the heat treatment of iron and steel. In the annealing of brass labor costs have been reduced considerably by the less oxidation of electrically annealed brass, requiring much less time for pickling. Better working conditions give a lower labor turn over, and lower labor costs result.

Better grade of product and fewer rejections often follow the use of electric heat. This has been especially true in the baking of japan both in the automobile business and in machinery manufacturing, where the more even heating of the electric oven results in a minimum of rejections because all of the pieces charged to the oven are baked under approximately the same conditions. Electric furnaces installed for the carburizing of steel, especially small machinery parts, are said to have produced a much higher grade product than was previously produced in combustion furnaces. Millions of pounds of government cartridge brass have been annealed electrically without a rejection. In annealing brass tubing there is much less scaling of the product. However, in considering the electric furnace for the hardening or annealing of steel and the annealing of cast iron, it should be remembered that steel or cast iron if heated without packing, will oxidize in the electric furnace just as in the combustion furnace.

Fire and explosion risks are almost entirely eliminated by electric heat. Explosions in electric japanning ovens have been entirely eliminated since the first year of their introduction, when it was found that suitable ventilation was necessary to prevent any chance of explosion. Explosions in gas-fired japanning ovens have been numerous. The electric space heater is now used in many applications to eliminate fire risk. A recent

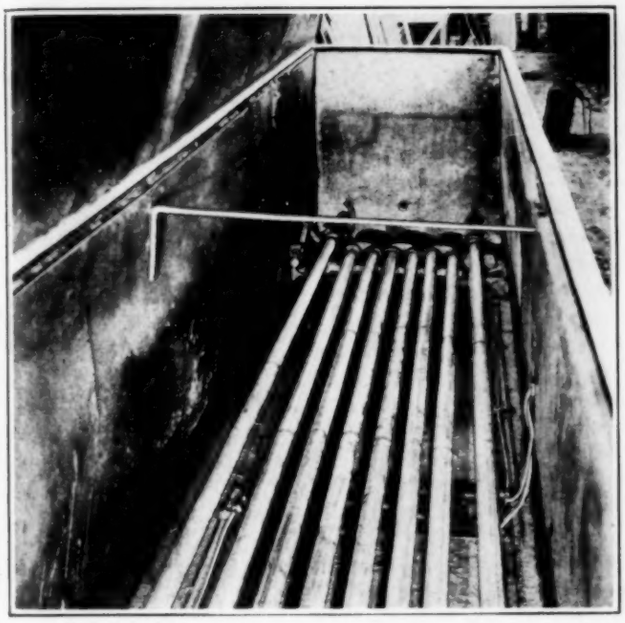


Fig. 4—4 Kw. Lumber Drying and Heating Box
This installation, together with the use of electrically heated glue pot resulted in the permanent shutdown of the boiler plant of a furniture factory

example is in the drying and setting of barrel staves. The former method was to burn waste wood in a small open salamander upon which the barrel was set. One factory recently burned down. Electric heaters have not only eliminated fire risk but have improved the quality of the barrels due to the more even and more gentle heating. In comparison with high pressure steam, electric heat has a much lower installation cost.

In the shoe industry the use of electric heat has progressed very rapidly through the installation of cartridge heaters on shoe machines with elimination of steam heat. Most modern shoe factories have electric heating and electric drive throughout the entire factory. There has been a recent tendency to eliminate all steam except for heating the building. A late innovation is electrically heated shoe conditioners, which are so designed as to permit continuous production regardless of the humidity of the outside air.

After the first rush of electric heating applications in the form of japanning ovens and heat-treating furnaces, progress has become gradual. The future seems assured, but progress may be retarded by too great optimism in making applications without consideration of the economies of a situation and the changes which may result in the chemistry or metallurgy of a process as a result of the use of a different form of heat. A tendency to place partially developed apparatus on the market exists; apparatus which has only passed through the draughting board stage and has not been subjected to a breakdown test or to thorough process tests. Any corporation considering the installation of electric heating should consider carefully not only the cost of operation, but also the reliability of the apparatus.

Damp Resisting Detonator

A superior detonator for high explosives has been devised by the Bureau of Mines. It has been found that silver azide retains its explosive properties regardless of the presence of moisture. This overcomes one of the objections of mercury fulminate which loses its sensitiveness under conditions of use in some mines.

Location of Chemical Plants

In a paper read before the Chemical Safety Conference, Wilmington, Del., May 22-23, 1925, W. H. Kiler said that the location of a chemical plant should be considered under three general headings: geographic, economic and topographic.

The *geographic location* will largely affect the materials of construction. The designer must allow for excessive rainfall, snow, ice, humidity, heat, wind, and other physical features imposed by climate. For example: A building constructed in our northern states must have ample provision for snow loading, must be provided with ice breakers on the roof, for protection against the forming of icicles over passageways, as well as for ample rain gutters and leaders. The same process in the southern states would indicate a different type of building construction as being most economical.

At one of our southern plants, we have provided for wind loads at a velocity of 65 miles per hour. It has run up our column, purlin and girt costs considerably but we have found it cheaper to take these costs than to take the risks involved by a weaker structure.

Likewise, the direction of prevailing winds should be studied so that fire doors of boilers and furnaces and doors of all chambers where hot or finely divided materials are handled, should be placed to leeward.

Relative humidity should be carefully considered. Where processes are affected by humidity and 24-hour operation is necessary, it may be advisable to resort to artificial conditioning of air. Likewise, the exposure of operators to excessive temperatures, dusts, etc., and protection against such hazards must be given every consideration.

The *economic location* is determined by the supply of materials, of power and labor; by markets and competition. The explosives plants should economically be located close to the consumers of their products because of the high freight rates on explosives. They can not ordinarily be located adjacent to the source of raw materials or power. In consequence, ample provision must be made for the storage of raw ingredients, and where purchased power is not available, provision must be made for the generation of power and ample fuel storage provided.

In other chemical industries, however, it is possible to locate close to consumers where ample power is available and no provision need be made for excessive storage of raw ingredients or for fuel. Where raw ingredients are brought into the plant or finished product shipped out in cargo lots, facilities for water transportation are of paramount importance. Where raw ingredients or finished product are shipped inward and outward in less than cargo lots, rail location is much to be preferred.

Topographical Location. The construction cost and efficiency of transportation systems conveying material into, through and away from the plant depends upon the skillful use of topographic features. The designer must consider whether the "hillside" type is superior or whether the "flat type" is best. It is most generally assumed the "hillside" or "gravity" type plant is superior, whether actually located on a hillside or whether the gravity conditions are brought about by multi-story design and construction. Gravity flow often considerably reduces the risks, because less power driven machinery and pressures apparatus, such as blow cases, are needed.

Rôle of Carbon Dioxide in Corrosion of Iron

Additional Experimental Evidence that Main Function of Carbonic Acid Is Removal of Ferrous Hydroxide Film

By T. Fujihara
Graduate Student, the Harvard Engineering School

Whitman and others have pointed out that an undisturbed film of water soon becomes saturated with iron and becomes alkaline, and then corrosion is greatly retarded. Others such as Baylis have shown that the main function of carbonic acid is in the removal of this and other material with which it can combine and form soluble bicarbonates, thus maintaining the necessary acid condition. Under water, that is, where a large excess of water is present, this usually does not hold, at least not to the same extent, and this paper places special emphasis on the influence of one factor in the electrolytic corrosion of iron. Much of the confusion in the past has been due to the new theories proposed which are based on an intensive study of one factor and the disregard of many other factors as pointed out by R. E. Wilson, and W. G. Whitman in papers that they have published in the last few years on this subject. Probably there has been enough discussion on theory for the present, and until there is considerably more information as to the action of all the factors involved and their relative importance in the different classes of corrosion, the present electrolytic theory is satisfactory enough, at least as a working hypothesis. In fact as more information is gathered, this one becomes better established as a basic theory.—EDITOR.

ACCORDING to the so-called acid theory, the corrosion of iron is primarily the result of acid attack, usually by carbonic acid. This unites with the iron yielding a ferrous salt, namely $FeCO_3$ or perhaps the soluble ferrous hydrogen carbonate ($FeH_2(CO_3)_2$) and the hydrogen liberated combines with any dissolved oxygen yielding water. The oxygen of the air then combines with the soluble iron salt to form the hydrated oxide or rust, liberating carbon dioxide which is now free to attack a fresh surface of iron. These actions may be represented by the following equation:

$$2Fe + H_2CO_3 = 2FeCO_3 + H_2$$

$$4FeCO_3 + 10H_2O + O_2 = 4Fe(OH)_3 + 4H_2CO_3$$

Clearly, therefore, a small amount of carbon dioxide in the presence of liquid water and oxygen could convert an indefinite amount of iron into rust. In order to prove this theory, a number of experiments have been carried out by many investigators such as Dunstan, Jowett and Gaulding (*Trans. Chem. Soc.*, 1905, vol. 87, p. 1548), Cushman (Bull. No. 30, U. S. Dept. Agriculture), Tilden (*Trans. Chem. Soc.*, 1908, vol. 93, p. 1358), Heyn and Bauer (Uber den Angriff des Eisens durch Wassen and Wassenrige Losungen, Mitterlungen ans dem Koniglichen Material-Prüfungsamt, 1908, vol. 2), Moody (*Trans. Chem. Soc.*, 1906, vol. 89, p. 720), Friend (*J. Iron & Steel Inst.*, 1908, vol. 11, p. 16), Lambert and Thomson (*Trans. Chem. Soc.*, 1910, vol. 97, p. 2425) who have discussed whether or not acid is essential to start corrosion. The present author also has made experiments on the same subject by which additional theory has been satisfactorily established.

Experiment 1. The apparatus employed for the experiment was constructed as follows:

A Jena flask and a U-tube were connected to a desiccator, first two named containing a dilute solution of caustic soda, the latter a concentrated solution of the same. The desiccator was then connected with a suction pump by which air was continuously drawn from the desiccator. In this manner the air in the desiccator was probably freed from carbon dioxide gas.

For the first experiment, two specimens were taken, one of electrolytic iron melted in vacuo, and the other of armco iron. These were finely polished with rouge and then etched with 5 per cent alcoholic solution of nitric acid from 30 min. to one hour. The treated specimens were then placed in the desiccator and subjected to corrosion with a few drops of freshly distilled water, at the same time the suction was started. The experiment, thus, was conducted under the desired condition. The water on each specimen was continuously supplied by means of syphon capillary tube from a dish which was placed by the specimen in the desiccator.

It was found that the specimen of armco iron remained bright for 15 days without any rusting, and one of electrolytic iron was not corroded for one month. This experiment was repeated a number of times and always with practically the same result; the experiment, however, failed sometimes due to improper manipulation and special attention is called to the following points:

(1) The desiccator must be kept filled with air free from CO_2.

(2) The specimen must be washed carefully after the treatment with nitric acid.

(3) The water used for this experiment must be freshly distilled and the amount on the specimen must be limited.

The specimens thus prepared by the author were corroded for 16 to 18 hr. in every case when they were brought out from the desiccator into the atmosphere.

Experiment 2. Two pieces of armco iron were taken as specimens in the same manner as in the first experiment. These were finely polished by the usual metallographic methods, but this time they were not etched. These specimens were tested in exactly the same manner as previously described in the last experiment. Rusting started in 10 or 20 minutes on both specimens and a maximum corrosion apparently was reached after 16 to 18 hr., and then the corrosion practically stopped. As a matter of fact, a little change was observed after one week or even two weeks except that rust was formed with condensed water on the surface of the metal outside of the boundary of the drop. When these specimens on which corrosion had practically stopped, were brought out from the desiccator into the atmosphere, it was found that the specimens started corroding over the entire area covered by the water.

From the foregoing experiments, the following conclusions may be drawn:

(1) Iron with clean surface will not continue to corrode in water and in air free from carbon dioxide after a film has formed as a result of rusting sufficient to protect the iron from further corrosion. This is,

From a thesis on the corrosion of iron presented to the Division of Mining and Metallurgy, the Harvard Engineering School, Harvard University, as part requirement for the degree of Doctor of Science in Metallurgy.

however, true only when a definite amount of water is used, as continued application of fresh water would remove the protective film and again induce rusting.

(2) Pure water and pure oxygen alone cannot attack iron on which a protective film previously is produced; but the additional action of carbon dioxide is necessary to produce rust as later explained.

The so-called acid theory has been attacked as stated above by many investigators such as Dunstan, Jowett and Goulding, Cushman, Tilden and Heyn and Bauer all of whom concluded that pure water and pure oxygen alone are sufficient to corrode iron. Furthermore, according to the theory, a small amount of carbon dioxide in the presence of liquid water and oxygen can convert an indefinite amount of iron into rust. The recent experiment made by the author, however, clearly indicated that rusting once started on iron will soon cease if carbon dioxide is excluded from air under which the iron is corroding. Keeping this experiment in mind, if the start of rusting is due to the presence of carbonic acid, the same carbonic acid should act to promote the subsequent corrosion of iron cyclically. The results obtained by the author's experiment therefore, clearly indicated the fact that carbon dioxide does not act on iron as the theory claims. It would seem therefore as if the so-called acid theory must be abandoned.

According to Friend's colloidal theory, corrosion is promoted chiefly by the catalytic action of ferric oxide sol. Likewise, this view has been disapproved by many investigators because of its lack of direct evidence and the foregoing experiment made by the author has clearly shown the fact that the colloidal theory cannot stand as an acceptable theory.

In spite of several attacks by the advocates of the other theories, the experimental evidence of investigators such as Evans, Speller and Whitman and Russell as well as the present author, apparently has proved the fact that corrosion is fundamentally electrochemical in nature. The electrolytic theory apparently has been accepted by most chemists as well as by metallurgists.

In spite of the protective effect of the alkaline film of the corrosion product, the fact is that iron which once starts to rust will continue to corrode until finally the whole piece is consumed. Clearly therefore a further explanation is necessary. The foregoing experiments by the author have thrown light on this point, showing that iron on which the protective film formed will not corrode with water in air free from carbon dioxide, but it will corrode immediately upon exposure to the atmosphere.

Carbon dioxide evidently plays an important part in the corrosion process, the action of which, however, is entirely different from that claimed by the present acid theory. The true action of carbon dioxide probably lies chiefly in the removal of the protective film as is shown in the following equation:

$$\underset{(\text{protective film})}{Fe(OH)_2} + \underset{(\text{dissolved } CO_2)}{H_2CO_3} = FeCO_3 + 2H_2O$$

$$FeCO_3 + H_2CO_3 = FeH_2(CO_3)_2$$

(soluble ferrous carbonate)

The main action is therefore that of carbonic acid on alkaline ferrous hydroxide; consequently corrosion will again start by the electrolytic process as before. In other words, the action of carbon dioxide observed by the author, occupies the secondary phase of the corrosion process, while the electrolytic theory explains the initial phase.

Metallic Corrosion in Concentrated Phosphoric Acid

By Fuller Clarkson and H. C. Hetherington
Fixed Nitrogen Research Laboratory

Laboratory investigation had indicated that it should be possible to produce ammonium phosphate commercially from ammonia and concentrated phosphoric acid using the same type of equipment as is employed in the manufacture of ammonium sulphate. The question then arose as to what materials could be used for the construction of this equipment and for handling phosphoric acid. Experiments were made on the corrosion of a number of metals by phosphoric acid under various conditions approximating those encountered in storage or handling of the acid, as well as those obtaining in an ammonium phosphate saturator. The results which are here very briefly reported must be regarded only as indicative of what may be expected of the materials studied.

Tests were made on lead, duriron, monel metal, tank-car steel and aluminum in phosphoric acid of 65, 72 and 80 per cent H_3PO_4 at approximately 20 deg. C. for a period ranging from 1 to 49 days. In testing the suitability of lead, duriron and monel metal for use in an ammonium phosphate saturator, a saturated solution of ammonium phosphate containing 10 per cent by volume of 72 per cent H_3PO_4 was maintained at a temperature of 100 deg. C. for a period of 20 days. The test specimens were in the form of small, flat squares or discs, 10 to 15 sq.cm. total surface and were clean, bright and free from oil. The solutions were not stirred during the test. At the end of the test period, the specimens were washed in a rapid stream of water, brushed free from adhering scale by means of a test tube brush, washed successively by means of a solution of alcohol and ether and finally dried and weighed. Very fair agreement was obtained in duplicate tests, except with monel metal.

1. Steel and aluminum are rapidly corroded by concentrated phosphoric acid at ordinary temperature.

2. Duriron is not corroded under conditions given in (1).

3. Monel metal is only slightly corroded under conditions given in (1), the rate of corrosion increasing with dilution of the acid.

4. Lead is corroded much more rapidly than monel metal, but the rate is not considered to be particularly serious.

5. Duriron is corroded somewhat more rapidly than monel metal under conditions approximating those which would exist in an ammonium phosphate saturator. The difference, however, is not marked.

6. Lead is corroded somewhat more rapidly under the conditions given in (5) than in (1).

7. From the preceding results, it appears that a saturator for making ammonium phosphate can be constructed of the same material as for sulphate, namely, a lead-lined wooden tank; that the ejectors and ammonia inlet pipes should preferably be of monel metal, although duriron may be used; that storage tanks for phosphoric acid should be lead-lined; and that tank cars other than wooden ones which are now being used to some extent, would at least have to be lead-lined.

Disinfecting and Washing Citrus Fruit

Solutions of Soap and Borax Markedly Effective, But Soft Water Necessary for Maximum Efficiency

By H. E. Shiver
Professor of Chemistry, Rollins College, Winter Park, Fla.

ONLY recently have solutions of soap and of borax been used in citrus fruit packing plants for washing and disinfecting. Usual practice is to dump the fruit in a tank containing a soap solution, which is thoroughly agitated. It is then conveyed by rollers into the borax solution tank containing 5 per cent borax solution at 115 to 120 deg. F. After remaining for about 5 min. in this tank, the fruit is then conveyed through brushes that coat the surface with paraffine.

According to Fulton and Bowman, (*J. Agr. Research*, 1924, vol. 28, p. 961) a 5-min. treatment with a 5 per cent borax solution at a temperature of 100 to 120 deg. F. is highly effective in reducing losses from blue-mold rot, and greatly reduces that from both *Phomopsis* and *Diplodia* types of stem-end rot. A large number of solutions of other disinfecting chemicals were used but in no case was the treatment so effective as that of borax.

These authors state that tests being made by the Office of Soil Fertility Investigations of the U. S. Department of Agriculture indicate that one orange has less than 0.025 gm. of surface borax after such treatment. This would indicate that the borax treatment comes well within the regulations of the Pure Food Act with regard to the use of borax as a preservative.

Wide use of these solutions in the packing plants of Florida has not been adopted owing to alleged complaints from northern markets to the effect that fruit reached them with a grayish cast on the surface. Furthermore, the plant consumed far more borax than was theoretically necessary.

Specific gravity control indicated that the borax solution was losing strength from day to day. In order to bring the solution back to the desired strength, fresh borax was added daily together with a little water to make up for that lost by evaporation and carried away by the wet fruit. The above procedure was followed daily for about 2 weeks without avail, at the end of which time the tank was discharged and cleaned. It was noted that a heavy, slimy deposit was always found in the bottom of the tank, but this could not be wholly explained as sodium borate crystallizing from the hot solution upon cooling, as the tank was drained while the solution was at a temperature of about 100 to 110 deg. F.

With this in mind, the various units were subjected to test with the following results:

(a) A sample of the water used throughout the plant analyzed as follows:

Temporary hardness	$CaCO_3$	..	14.5 parts per 100,000
Permanent	"	"	..10.5 parts per 100,000
Total	"	"	..25.0 parts per 100,000

(b) Analysis of the residue collected at the bottom of the tank after the solution had been drained off, and using a sample extracted with water and HCl was as follows:

Calcium carbonate	12.56 per cent
Magnesium carbonate	3.08 per cent
Dirt, fruit pulp, peel, etc.	74.47 per cent
Sodium borate	9.89 per cent

(c) Analysis of freshly prepared borax solution before use and of that after 2 weeks use, including daily additions of borax was as follows:

Sodium borate before use	5.49 per cent
Sodium borate after two weeks use	12.88 per cent

(d) A sample of the solution used in the soap washing tank analyzed as follows:

Calcium palmitate	8.57 per cent
Magnesium palmitate	1.89 per cent

(e) A number of oranges which had been through the treatment outlined above were analyzed for the gray deposit found upon the surface with the following results:

Calcium (as carbonate)	51.19 per cent
Magnesium (as carbonate)	6.79 per cent

The deposit analyzed above was obtained by scraping the surface of a number of oranges and owing to the fact that the orange skin contains a high percentage of calcium salts a more careful means of obtaining this sample was devised which upon analysis yielded the following:

Calcium (as carbonate)	8.16 per cent
Magnesium(as carbonate)	1.81 per cent
Sodium borate	9.59 per cent
Paraffine, dirt, etc.	80.44 per cent

Sodium borate, commercial borax, being formed from a strong base and a weak acid is hydrolyzed as follows:

$$Na_2B_4O_7 + 7H_2O = 2NaOH + 4H_3BO_3 \quad (1)$$

When a borax solution is made up with hard water, the following series of reactions occur:

$$Ca(HCO_3)_2 + 2NaOH = CaCO_3 + Na_2CO_3 + 2H_2O \quad (2)$$

and

$$CaSO_4 + Na_2CO_3 = CaCO_3 + Na_2SO_4 \quad (3)$$

The result is that the calcium and magnesium salts causing both temporary and permanent hardness, precipitate from the solution. As more borax and water is added from day to day the series of reactions given above recur with subsequent lowering of the density of the solution.

It will be noted that the solution increases in borax content from about 5 per cent to about 12 per cent. With solutions of such strength, the treated fruit carries away a thin film upon its surface which upon drying deposits crystals of sodium borate. This serves to lower the density of the tank solution and imparts to the fruit a grayish cast. The rollers which convey the fruit in its moist condition from the treatment tank to the paraffine brushes soon become coated with borax and is also partly responsible for the grayish coating given to the fruit.

Undoubtedly part of the calcium found in this surface deposit is obtained in the soap washing tank. A soluble sodium soap is used that reacts with the calcium salts of the water thus,

$$2NaCO_2C_{17}H_{35} + Ca(HCO_3)_2 = 2NaHCO_3 + Ca(CO_2C_{17}H_{35})_2 \quad (4)$$

This precipitate is the characteristic slimy, clinging scum formed when soap and hard water is used for washing purposes. It penetrates the pits and crevasses of the fruit and is very difficult of removal. Forming, as it does, a floating scum upon the surface of the tank it has an unusual opportunity to attach itself to the fruit. With the use of soft water none of the objectionable features found above have presented themselves.

Editor's Note—In any operation using large quantities of soap solution, the control of concentration is vital. Preliminary softening of the natural water will usually result in worth-while savings in soap consumption, besides ridding the wash water of objectionable slimes such as have been described by Professor Shiver.

On the Engineer's Book Shelf

Physical Metallography

PHYSICAL METALLOGRAPHY. By Prof. Dr. Ing. Ehr. *E. Heyn*, Geh. Reg. Rat., late Director of the Kgl. Materialprüfungsamt and of the K. W. Institut für Eisenforschung; translated from the German and somewhat augmented by *Marcus A. Grossman*, metallurgical engineer, United Alloy Steel Corporation. John Wiley & Sons, Inc., New York. 440 pp. Price $6.

Reviewed by E. E. Thum

The high standing of both the German author and the American translator leaves no doubt but that the contents of the present book is authoritative and represents the most advanced ground taken by this relatively new branch of science. Much of the text will be recognized by the physical chemist as representing familiar matter, although the field of equilibrium diagrams, temperature measurements, and the study of phase changes has been developed along special lines to an extent which he probably will never need. A study of the inner structure of metals is also a specialized branch of microscopy, owing to the fact that the subject is opaque and must be viewed by reflected light. Many of the familiar optical tests common to the study of the transparent crystals and solutions, are therefore impossible to use.

The latter portion of the book is devoted to a study of relationship between crystal structure, stress, and strain, with particular reference to the practical matter of fracture of metal under uniform or oft-repeated loads. Such properties, of course, vary widely with the mechanical treatment, the heat treatment, and in general, the past history of the specimen.

By and large, the book should be a valuable addition to the library of a progressive metallurgist of the new school—particularly valuable because it represents the viewpoint of one of the leading foreign investigators from whom we have been intellectually isolated for a decade. It would seem, however, that a chemist, having a desire to become acquainted with the subject matter of this book, would find fewer stumbling blocks in the pages of, say, "Introduction to Physical Metallurgy," by the Englishman, Walter Rosenhain. It reads better and makes a better picture.

Carnegie Steel Handbook

THE MAKING, SHAPING AND TREATING OF STEEL. Fourth Edition. By *J. M. Camp* and *C. B. Francis*. Published by Carnegie Steel Company, Pittsburgh, Pa. 1142 pp. Price, $7.50; 60 per cent discount to employees of the U. S. Steel Corporation, educational institutions and public libraries.

In this, the fourth edition of this book within 6 years, Carnegie Steel Company again makes available to the public a volume, a large part of which represents what is essentially a new work on the metallurgy of iron and steel. Although the previous editions were written mainly as a text and reference book for employees of the Carnegie Company, this edition has been expanded to meet the needs of all the subsidiary companies of the U. S. Steel Corporation, not only as a text for use in the various schools conducted by these companies, but also as a reference book for employees.

In addition to revising the old text, much new matter has been added, making the present volume about twice the size of the previous edition. In brief, the book now covers more or less completely the metallurgy of pig iron, wrought iron, and all kinds of wrought steel, from the mining of the ore and other raw materials to the finished products ready for fabrication, including tool steels, wire, sheets and tubes. Although endeavoring to retain the scientific viewpoint, the authors have aimed to place emphasis upon the sure and practical—on what has been found to work in every day practice—rather than upon untried theories and opinions.

Recognizing the value of history, particularly in helping investigators to avoid the mistakes, or duplicating the work of others, more space has been given to this side of the subject than in any of the previous editions. The unusually detailed table of contents supplies a complete outline of the book, useful to students for review purposes and to the general reader who desires to get a grasp of the whole subject quickly.

Metallurgy and Materials

METALLURGY OF ALUMINUM AND ALUMINUM ALLOYS. By *Robert J. Anderson*, consulting metallurgical engineer. Henry Carey Baird & Co., Inc., New York. 944 pp. Price $10.

Anderson's work is an inclusive book and the only one within recent years, on the metallurgy of aluminum and its many alloys. An excellent scheme of bibliographical material supplements the broad theoretical and descriptive discussions, and this feature alone makes it worth-while as a source of reference for the busy engineer.

A COURSE OF METALLURGY FOR ENGINEERS. By *F. C. Thompson*, professor of metallurgy in the Victoria University of Manchester. H. F. & G. Witherby, London. 240 pp. Price 25s.

If we should attempt to analyze the troubles of the plant engineer in chemical works, problems concerning materials of construction would take front rank position. Metals, of course, are the most important of these materials, and the development, within recent years, of a multitude of special alloys and protective coatings has increased their applicability. An understanding of general metallurgy is therefore of considerable utility even to the production executive.

This book is an effort to express within small compass, and in simple language, the fundamentals of ferrous and non-ferrous metallurgy for the engineer. It is remarkably well done and includes chapters on steel, cast iron, brass, bronze, aluminum alloys and bearing metals that are sufficiently inclusive. From the standpoint of the chemical engineer alone, the omission of discussion of copper-steels, copper-nickel alloys, and high-silicon iron is somewhat disappointing; this is a minor defect however, caused undoubtedly by the necessity of limiting the book to a modest size.

CHEMISTRY OF ENGINEERING MATERIALS. By *Robert B. Leighou*, professor of chemistry in the Carnegie Institute of Technology. McGraw-Hill Book Company, Inc., New York. Second Edition, 538 pp. Price $4.

This is the second edition of a well-known book that appeared originally in 1917. Sufficient changes and additions have been made to bring the subject matter thoroughly up to date, and the work remains as a leader in its field. It is not clear why certain important engineering materials such as wood, glass and paper are not discussed, whereas 35 pages is given to primary and secondary electrolytic cells, a subject that is perhaps afield in a book of this type. However, this is a question of contents planning that can easily be remedied, and is not a major criticism.

MATERIALS AND THEIR APPLICATION TO ENGINEERING DESIGN. By *E. A. Allcut*, associate professor of thermodynamics, University of Toronto, and *E. Miller*, metallurgical engineer, Incandescent Heat Co., Ltd., Birmingham. J. B. Lippincott Company, Philadelphia. 519 + pp. Price $12.50.

An outstanding feature of this book on engineering materials is the exceptional thoroughness shown in its preparation, and the wealth of data gathered from industrial sources. Although tne metallurgy and testing of ferrous metals forms the body of the text, nonferrous alloys and non-metallic materials have not been neglected. It is hardly an every-day book for the chemical engineer, but rather one that in his library will lend a sense of security as a reference work in matters of design.

Organic Antimony Compounds

ORGANIC DERIVATIVES OF ANTIMONY. By *W. G. Christiansen*. American Chemical Society, Monograph Series. The Chemical Catalog Company, New York. 230 pp. Price $3.

Reviewed by George Calingaert

As soon as some application is found for a chemical compound, scores of chemists investigate the field, and independent publications are likely to multiply profusely.

Such was the case with the organic compounds of antimony. In 1908, it was reported that they had been used with hopeful results in the treatment of a series of dangerous spreading diseases, of which the familiar sleeping sickness is one type. As a result, an extended investigation of the subject was started in many laboratories. The chemical and medical publications of the last decade were thus enriched by many uncorrelated data, and it became a necessity to have the subject presented systematically, critically and yet thoroughly, by a man familiar with it. W. G. Christiansen, by his specialized study of these compounds and their effect in curing tropical diseases, was qualified to undertake such a task, and his book lives up to the requirements of the situation.

The first part, 116 pp., is devoted to a general description of the various antimony compounds, their reactions and characteristics, and contains a chapter well worth while mentioning by G. C. Shattuck on therapeutic action, especially in connection with the treatment of tropical diseases. A systematic survey of the preparation, properties, reactions and analysis, forms the second part of the work.

Christiansen, judging from his book, was obviously more interested in the medical side of his study than the chemical: the second part gives the feeling of being restricted to an impartial description, systematic and complete, but hardly critical, whereas the first part is a true critical study in which the author shows his mastery of the subject. The large number of types of organic antimony compound makes the nomenclature somewhat involved and a clear definition of the various names used might have helped greatly. The unprepared reader may be disconcerted by such inconsistencies as the use of the word "antimonial" as synonymous with "stibine" in Chapters I and II, and with "antimonyl" in Chapter VI. A bibliography, author, subject and patent index complete the volume.

From beginning to end the book is attractive reading for anybody interested in the subject, either as a physiologist eager to know the therapeutic properties of antimony, or as a research chemist curious of the versatile behavior of metals in their organic compounds.

The Case for the Petroleum Industry

AMERICAN PETROLEUM: SUPPLY AND DEMAND. A report to the Board of Directors of the American Petroleum Institute by a Committee of Eleven Members of the Board. McGraw-Hill Book Co., Inc., New York. 269 pp. Price $3.

Reviewed by S. D. Kirkpatrick

This book might well be termed "The Petroleum Industry's Answer to the Alarmist and the Politician." It is the first authoritative statement from the industry itself designed to lay low the sensational and oftenrepeated charge that the country is facing a petroleum famine brought on largely by a frenzy of wasteful exploitation. It is propaganda, to be sure, but the convincing sort that sets forth impartial facts and figures as the basis for straight thinking on economic questions. It is an effective answer to the demand heard from some quarters for government regulation or even ownership of our oil rsources. In its stead the industry asks only for security in the ownership of its property and the privilege of developing it under conditions permitting the exercise of initiative, liberty of action, the play of competition and the free working of the law of supply and demand.

This report, although nominally the work of a committee of eleven, in reality reflects the results of a country-wide survey participated in by a great number of representatives of the industry. The study indicated petroleum recoverable by present methods of pumping and flowing from existing wells or acreage already proved to be oil-bearing, to consist of 5,300,000,000 bbl. And there remains in this producing area after pumping and flowing fail, 26,000,000,000 bbl., of which a considerable portion will be recoverable by flooding, pressure or mining methods that have already proved practical. The committee does not lose sight of the fact that there is an additional reserve in the vast deposits of oil shale from which a practically unlimited supply of liquid fuels and lubricants may be obtained if and when the cost is justified. Excellent chapters contributed by Horace C. Porter and Ross H. Dickson complete the picture with a discussion of the tremendous possibilities in the production and utilization of liquid fuels from coal and lignite.

From the viewpoint of the economist greatest interest attaches to the report on the probable future demand. Here are authoritative studies of the future trends in population and industrial growth and their relation to the consumption of petroleum products.

In short, the book presents a wealth of information which students of practical economics in all industries will welcome. The petroleum industry has not only effectively answered its critics but has established a standard for gaging its present, past and future development.

Plant Technology

BACTERIOLOGY. By *Stanley Thomas*, associate professor of bacteriology, Lehigh University. McGraw-Hill Book Company, Inc., New York. 201 pp. Price $2.50.

To industrial chemists and chemical engineers, bacteriology has ceased to be a science merely of academic interest. Already, industries for making ethyl alcohol, butyl alcohol, lactic and acetic acids and acetone have been built upon the foundation of enzyme action, and a number of others, such as sugar refining, packing, tanning, and canning, have a vital interest in bacteriology. Further developments of importance in bacterio-chemical technology are a certainty, and for the technical man who would be prepared, this easily read text book on fundamentals should be decidedly useful.

AUTOCLAVES AND HIGH PRESSURE WORK. By *Harold Goodwin*, M.Sc. Ernest Benn Ltd., London. 166 pp. Price 6s.

Into this small book is packed years of intensely practical experience in the operation of autoclaves, both large and small, and with various major type reactions. Underlying each recommendation in practical operation, there is a corresponding basis of theory, clearly and soundly presented. The research, development or plant engineer cannot help but find immediate satisfaction in the information given.

FAN ENGINEERING. Edited by *Richard D. Madison*, under the direction of *Willis H. Carrier*. Published by The Buffalo Forge Company, Buffalo. 610 pp. Price $4.

This second edition of the original manual by Willis H. Carrier, brings the subject matter of fan engineering up to date. Part I discusses the theory of humidification, air flow and psychometry. Part II takes up the practical application of fans in problems of heating, ventilating, air washing, mechanical draft, drying and conveying. The entire text is replete with tables, charts and drawings, and the physical arrangement of the material is excellent.

Business Practice

ORGANIZATION OF PRODUCTION. By *John W. Curtis*, M. B. E., A. M. I. Mech. E. Ernest Benn Ltd., London. 141 pp. Price 6s.

Chemical engineers, except those interested specifically in gas engineering, will probably be disappointed in the plan and subject matter of this book, which might well have had a much greater proportion of discussion of functional control for chemical industry in general, and with less attention to details of erecting plant and equipment.

COST ACCOUNTING PRINCIPLES AND PRACTICE. By *J. P. Jordan*, consulting management engineer, and *Gould L. Harris*, assistant professor of management, School of Commerce, Accounts and Finance, New York University. The Ronald Press Company, New York. 562 pp. Price $4.

Many staff engineers, in their specialized professional work, have little or no opportunity for experience in cost accounting; but when these same engineers assume the greater responsibilities of consulting, or of managing, they must face the problem of control through cost reports. Jordan and Harris, in their revised book, have produced a dependable text for the engineer. Basic principles, illustrated by practical statements and forms, have been outlined in a clear and logical manner. This is particularly true of the subject of "burden," the theory of which is but imperfectly understood by a goodly proportion of industrial executives.

PRINCIPLES OF INVESTMENT. By *A. M. Sakolski*, investment analyst for Paine, Webber & Co. The Ronald Press Company, New York. 503 pp. Price $4.50.

When the chemical engineer becomes part or sole owner of a manufacturing enterprise, he must be much more than a competent technologist in order to succeed. A working knowledge of investment principles, and particularly those applying in the more shifting field of chemical manufacturing, may easily prevent an early failure. For the engineer not schooled in finance, as well as for the seasoned business executive, Dr. Sakolski's book should be of constant help.

CONFERENCES COMMITTEES, CONVENTIONS AND HOW TO RUN THEM. By *Edward Eyre Hunt*. Harper & Brothers, New York. 218 pp. Price $2.50.

The group conference and convention have come to be a necessity, made so because of the ever-increasing complexity of modern business. It has been estimated that at least 10,000 important conferences are held each year, and when it is realized that the cost ranges from at least several hundred dollars to upwards of $100,000, their economic significance at once becomes apparent.

This book might be entitled "What Every Secretary Ought to Know" because it covers a lot of the common sense phases of running conventions that are too often neglected by secretaries who are responsible for them. If anyone is inclined to criticize the book on the score that it deals with self-evident matters, the reply can be pertinently made that those are the things most often neglected by people who are charged with conduct of conventions. The author covers the tactics and strategy of conferences remarkably well, drawing on an extensive experience in the government service. He emphasizes the necessity of outlining the problem, planning, organizing and directing the meeting, recording its transactions and measuring its results. Budgeting the expense and keeping within the budget, handling the publicity and other practical phases of the problem receive due attention. In a series of appendices the author gives practical examples of subjects discussed in the text.

Chemical History

CHEMISTRY AT THE TIME OF DALTON. By *E. J. Holmyard*.. Oxford University Press, American Branch, New York. 128 pp. Price $1.

In this, the third volume of "Chapters in the History of Science," the development of chemical science is traced from antiquity to the establishment of the atomic theory by John Dalton. As far as possible, original sources have been used, and these include extracts and illustrations not generally known to readers of other works on chemical history.

Recent Legal Decisions

Digest of typical cases decided in high courts, illustrating principles of law applied to business transactions

Pauling Patent For Concentrating Nitric Acid Invalid

In the U. S. District Court for the District of New Jersey, Judge Bodine dismissed the suit of the Southern Electro-Chemical Co. vs. E. I. du Pont de Nemours and Co. for infringement of the Pauling patent, 1,031,864, for the concentration of nitric acid. The Pauling process consists in passing a mixture of aqueous nitric acid and sulphuric acid countercurrent to an upward flow of steam in a vertical column or tower suitably packed. The flow of steam is so regulated that concentrated nitric acid vapors leave the top of the column while the sulphuric acid carrying substantially all the water originally in the dilute nitric acid flows out at the bottom. The patent specifies that "the best results are obtained with mixtures free from impurities such as organic matter"; also that "by using a path of sufficient length nitric acid of the highest possible concentration is obtained, and practically all traces of nitric acid are removed from the sulphuric acid."

The plaintiff contended that the duPont Co. infringed the Pauling process at one of its plants in Delaware. The duPont defense was, in effect, that the Pauling process was anticipated by the prior art because it is the same as occurs when a steam-heated denitrating tower is efficiently operated without excess of steam; that such a tower, when efficiently denitrating spent mixed acid from explosive manufacture, performed the same process as that of the Pauling patent, except for the action of organic matter on the otherwise highly concentrated nitric acid; that there was nothing patentable in omitting organic matter from the feed to such a tower; and that the only process unavoidably practiced in efficient denitration is identical with the process of the Pauling patent and therefore an anticipation of it.

During the progress of the suit the court permitted both the defendant and the plaintiff to make certain tests at Repauno, N. J. and Warners, N. J., respectively. The Repauno tests were conducted in 13-ft. and 24-ft. denitrating towers, known to the prior art, on mixed acid free from impurities, nitroglycerine waste acid and nitrocellulose waste acid. Results were substantially the same with the same types of acids in both towers, except that high concentration of nitric acid was obtained only from mixtures substantially free from organic matter. In all cases, however, substantial concentration of nitric acid occurred at the top, and substantial denitration of the sulphuric acid at the bottom of the towers.

The plaintiff's tests at Warners with a prior art tower gave results "in exact accord with the results at Repauno," from which the Court concluded that "prior art towers would, when substantially pure acids were used, effectively concentrate nitric acid while effectively denitrating the sulphuric acid." Also, in the opinion of the Court, excerpts from the testimony "support the defendant's contention that as soon as it was apparent that the Warners tests would support the case of the defendant, more steam was applied which of course, diluted the nitric acid and the sulphuric acid."

In dismissing the bill the Court found that Pauling has done nothing new. "He used an old process and secured what the prior art knew would be secured from the use of the purer materials."

Heat and Pressure Patent for Bakelite Declared Not Infringed

The Brunswick-Balke-Collender Co. manufactures billiard balls using therein a filler and a binder consisting of a phenolic condensation product—a condensed or dehydrated product resulting from the reaction of phenol and formaldehyde upon each other. The Bakelite Corporation, plaintiff in a suit in the District Court of the United States for the District of Delaware, alleged that the manufacture of this condensation product was an infringement of claims contained in its patents 942,699 and 942,809. In the former, known as the "heat and pressure patent," Dr. Baekeland, the patentee, clearly indicated that the process was divided into two stages. For example Claim 1 reads:

> 1. The method of producing a hard, compact and infusible condensation product of phenols and formaldehyde, which consists in reacting upon a phenolic body with formaldehyde, and then converting the product into a hard, insoluble and infusible body by the combined action of heat and pressure.

The question in connection with this patent turned on whether or not the defendant's material was infusible and insoluble within the meaning of the above claim and whether or not there was an actual division of the process into the stages indicated. Judge Morris held that the method employed by the defendant was that of the prior art, that the reaction did not divide itself into true stages and that the properties of the product were varied merely by continuing for a longer time the application of heat and pressure. For that reason he held that the defendant did not employ the "heat and pressure" patent and therefore did not infringe the claims in issue.

Effect of German Peace Treaty on Time Limitation for Filing U. S. Application After Issuance of German Patent

On Oct. 11, 1915, one Stoffregen filed a German patent application and patent was issued on Oct. 20, 1919. On May 10, 1922, approximately six and a half years after the filing of the German application, he filed application for a United States patent. It was conceded that this application was barred by Sec. 4887 of the revised statute and was not saved by the Nolan Act of March 3, 1921, which expired Sept. 3, 1921. The applicant contended, however, that under the treaty of peace between the United States and Germany of Nov. 11, 1921, the time for filing in this country was extended six months from that date, within which period his application was filed. The Patent Office contended that the treaty required legislation to make it effective as far as it related to patents and refused to allow the applicant to lay claim for a patent on the ground that his application was barred by lapse of time. The Court of Appeals of the District of Columbia ruled that the Patent Office should be affirmed in its decision. The treaty of peace was not self-executory and did not automatically extend the time for filing as the applicant contended.

Recent Articles in Technical Periodical Literature

By P. K. Frolich
Massachusetts Institute of Technology

Petroleum. Colloids in the petroleum industry. A. E. Dunstan, F. B. Thole and W. H. Thomas, *Chem. & Ind*, 1925, vol. 44, pp. 439-43; also, Removal of sulphur from petroleum distillates by silica gel. H. I. Waterman and J. N. J. Perquin, *Brennstoff-Chemie*, 1925, vol. 6, pp. 255-7.

Motor Fuels. Methods of producing light oils for internal combustion engines. M. Brutzkus, *Chim. & ind.*, 1925, vol. 14, pp. 171-86.

Oil Burning. Discussion of advantages and disadvantages of various means of atomizing oil. A. F. Brewer, *Combustion*, 1925, vol. 13, pp. 153-7.

Tar Paint. Use of tar as a protective coating for various materials. E. O. Rasser, *Kunstoffe*, 1925, vol. 15, pp. 131-4.

Carbonization. Report on the low-temperature carbonization of coal. Allgemeine Kohlenverwertungs Ges., *Apparatbau*, 1925, vol. 37, pp. 220-1.

Ethyl Alcohol. Review of various methods of making ethyl alcohol. E. Girod, *Rev. Chem. Ind.*, 1925, vol. 34, pp. 206-10; 238-43.

Waste Disposal. Effluents from ammonia plants and their disposal. T. L. Bailey, *Chem. & Ind.*, 1925, vol. 44, pp. 835-45; also, distillery waste liquids and their purification. R. D. Littlefield, *loc. cit.*, pp. 860-7.

Sulphite Liquor. Progress in the combustion of sulphite liquor. Pradel, *Apparatbau*, 1925, vol. 37, pp. 221-2.

Water-Softening. Preparation and comparative performance of base-exchange water-softening materials. E. B. Higgins and J. P. O'Callaghan, *Chem. & Ind.*, 1925, vol. 44, pp. 882-5; also, recent experiments with Doucil as a water-softening material. T. P. Hilditch and H. J. Wheaton, *loc. cit.*, pp. 885-7.

Extraction. Discussion of stationary extraction equipment in the oil and fat industry. B. Hassel, *Chem. Ztg.*, 1925, vol. 49, pp. 721-3.

Waterproof Fabrics. Review of various methods for making waterproof fabrics and tissues. Schwarz, *Kunstoffe*, 1925, vol. 15, pp. 137-41.

Casein. Casein and its industrial applications (the first of a series of articles on this subject). F. C. C. Lynch, *Canad. Chem. & Met.*, 1925, vol. 9, pp. 203-5.

Titanium White. Possibilities of making titanium white from Canadian ilmenite. H. A. Leverin, *Canad. Chem. & Met*, 1925, vol. 9, pp. 198-9.

Aluminum. Use of aluminum as a material of construction in the chemical industry. J. Fritsch, *Rev. Chem. Ind.*, 1925, vol. 34, pp. 215-18.

Electrolytic Nickel. Chemistry of the Hybinette nickel-refining process. F. E. Lathe, *Chem. & Ind.*, 1925, vol. 44, pp. 433-8T; 443-4T.

Silica Gel. Use of silica gel in purification of gases with special emphasis on the apparatus in question. F. W. Horst, *Chem. Apparatur*, 1925, vol. 12, pp. 159-61.

Explosives Industry. Progress in the chemistry and manufacture of explosives in the years 1914-1923. A. Stettbacher, *Chem. Ztg.*, 1925, vol. 49, pp. 666-7; 682-4; 713-6; 729-32.

Government Publications

The Physical Chemistry of Oil-Field Emulsions by D. B. Dow and C. E. Reistle, Jr. Bureau of Mines Serial No. 2692.

Present Trend in Flotation Flow-Sheets and Classification of Flotation Feed by A. W. Fahrenwald. Bureau of Mines Serial No. 2694.

Indicator for Combustible Gases in Air by L. H. Milligan. Bureau of Mines Technical Paper No. 357.

French Fertilizer Trade During 1924. Special Circular No. 108—Chemical Division, Bureau of Foreign and Domestic Commerce.

Mineral Production Statistics—U. S. Geological Survey pamphlets Sulphur and Pyrites in 1924 by H. M. Meyer; Cadmium in 1923-24 by C. E. Siebenthal and A. Stoll.

Similar reports from the Bureau of Mines, as mimeographed preliminary statistical statements: Gypsum in 1924; Stocks of Coal June 1, 1925; Sales of Feldspar in the United States in 1924; The Iron Industry in 1924; Production of Metals from Secondary Sources in 1924; Manganese Production Increases in 1924; Production of Stone in the United States in 1924; Petroleum Statistics for June, 1925, (combining statistics of crude petroleum, formerly issued by the U. S. Geological Survey, with statistics of refined products.)

Gas Cylinder Construction Specifications. Additional Steel authorized. Interstate Commerce Commission order July 22, 1925.

Pulp Wood Consumption and Wood-Pulp Production. Mimeographed preliminary statement from the Bureau of the Census.

Vegetable fibers other than cotton. Tariff information surveys No. FL-16.

Studies on Industrial Dust Problem by Leonard Greenburg. Public Health Service Reprint No. 1004.

Screen Sizing of Coal, Ores and Other Minerals. By E. A. Holbrook and Thomas Fraser. Bureau of Mines. Bulletin No. 234.

Tests of a Large Boiler Fired with Powdered Coal at the Lakeside Station, Milwaukee. By Henry Kreisinger, John Blizard, C. E. Augustine and B. J. Cross. Bureau of Mines. Bulletin No. 237.

Sources of Limestone, Gypsum, and Anhydrite for Dusting Coal Mines to Prevent Explosions. By Oliver Bowles, Bureau of Mines Bulletin No. 247.

Production of Explosives in the United States During the Calendar Year 1924, with Notes on Mine Accidents Due to Explosives. By William W. Adams. Bureau of Mines Technical Paper No. 380.

Mineral Resources of the United States in 1924 (Summary Report). With introduction by Frank J. Katz; statistics assembled by Martha B. Clark from data furnished by specialists of the Division of Mineral Resources. Unnumbered report of U. S. Geological Survey.

Gold, Silver, Copper, Lead and Zinc in New Mexico and Texas in 1923. Mine Report by C. W. Henderson. U. S. Geological Survey publication I:27.

Quicksilver in 1924. By Clyde P. Ross. U. S. Geological Survey publication I:3.

Bauxite and Aluminum in 1924. By James M. Hill. U.S. Geological Survey publication I:4.

Tin in 1924. By Bertrand Leroy Johnson. U. S. Geological Survey publication I:5.

Peat in 1924. By K. W. Cottrell. U. S. Geological Survey publication II:3.

Fuller's Earth in 1924. By Jefferson Middleton. U. S. Geological Survey publication II:2.

United States Government Master Specification for Rubber Goods (Methods of Physical Tests and Chemical Analyses). Federal Specifications, Specification No. 59a. Circular of the Bureau of Standards No. 232.

Extention Work in Foods and Nutrition, 1923. By Miriam Birdseye. U. S. Department of Agriculture Circular No. 349.

Animal and Vegetable Fats and Oils: Production, Consumption, Imports Exports and Stocks by Quarters, Calendar Years 1923 and 1924. By William L. Austin and Harvey J. Zimmerman. Unnumbered publication of the Bureau of Census.

Report of the National Conference on Utilization of Forest Products. U. S. Department of Agriculture Miscellaneous Circular No. 39.

Comparative Durability of Chrome and Vegetable Tanned Sole Leathers. By R. C. Bowker and M. N. V. Geib. Bureau of Standards Technologic Paper No. 286.

A Hot-Wire Anemometer for Measuring Air Flow Through Engine Radiators. By Carl G. F. Zobel and L. B. Carroll. Bureau of Standards Technologic Paper No. 287.

Comparative Cold-Rolling Tests of Open-Hearth Steel Strips (Deep-Drawing Stock) and Electrolytic Iron Strip. By John R. Freeman, Jr., and R. D. France. Bureau of Standards Technologic Paper No. 288.

Comparative Slow Bend and Impact Notched Bar Tests on Some Metals. By S. N. Petrenko. Bureau of Standards Technologic Paper No. 289.

Labor Laws of the United States with Decisions of Courts Relating Thereto. Bulletin of the U. S. Bureau of Labor Statistics No. 370.

Commerce Year Book Issued

The 1924 "Commerce Year Book" has been issued by the Department of Commerce. This document is a very valuable summary of production, import, export and marketing information in many industries, both for domestic and foreign trade. The various chapters include: Discussion on metals, construction materials; fuel and power; textiles; labor; paper; chemicals; rubber; and many other commodities of interest to the process industries. The cloth bound volume is available at $1. per copy from the Superintendent of Documents, Government Printing Office, Washington, D. C.

The Plant Notebook

An Exchange for Operating Men

Electrical Heating for Vacuum Impregnating Apparatus

By C. L. Smith
Manufacturing Superintendent
General Electric Co., Lynn, Mass.

Desire for a superior product having a high insulation value was responsible for the introduction of the vacuum impregnating process at the West Lynn Works of General Electric Co. The compound used is a resinous gum melting at approximately 100 deg. C. and utilized at temperatures of 160 to 170 deg. C. Electric heat has proved economical and well adapted to the heating and control of this process.

The apparatus consists of one 3,000 gallon mixing tank and two 1,500 gallon treating tanks fitted with removable covers capable of being clamped or sealed to maintain either vacuum or heavy internal pressure. Each tank is fitted with a number of cast-iron center heating units giving a connected load of 63 kw. and transfer pipes between tanks are heated with sheath wire elements. The entire equipment is very heavily insulated (11 inch thickness of heat insulation) to reduce the heat losses to a minimum. Control of the temperature is automatic but adjustable so that different compounds having a wide range of flow points can be used if desired.

The sensitive bulb of the temperature control instrument is located in the heating chamber but with the bulb in contact with the outside surface of the steel tank. In addition to other control apparatus, two temperature limit fuses are inserted in the heating chamber on opposite sides of the tank. These fuses melt at about 600 deg. F. and, at that temperature, throw off all power from the heating equipment until new fuse links are inserted. The material used in these fuses is easily obtained, being either pure lead or a lead tin alloy wire, approximately ¼ inch in diameter.

Electrically Heated Vacuum Drying and Impregnating Tanks

The treating process requires approximately 24 hours for each heat. About 8,000 lb. of material are treated at one operation.

A very thorough test, extending from February 7 to September 4, 1924, showed the following results:

Number of heats		200
Number of days		210
Number of hours		5,040
Weight of units treated		1,115,011 lb.
Number of units treated		55,798
Average weight per heat		5,575 lb.
Average number of units per heat		279
Total kw.-hr. consumption melting tank	19,271.7	kw.-hr.
First treating tank	20,253.1	kw.-hr.
Second treating tank	21,834.9	kw.-hr.
Transfer pipes	21,163.1	kw.-hr.
Week end and idle periods melting tank	1,268.3	kw.-hr.
Week end and idle periods first treating tank	8,086.9	kw.-hr.
Week end and idle periods second treating tank	3,725.1	kw.-hr.
Total kw.-hr. consumption	95,603.1	kw.-hr.
Kw.-hr. per 100 lbs. treated	8.574	kw.-hr.
Kw.-hr. per ton treated	171.48	kw.-hr.
Kw.-hr. per hour for operating costs	13.96	kw.-hr.
Kw.-hr. estimate for yearly operation	166,078.	kw.-hr.

Experimental Kiln and Beehive Kilns in Refractory Brick Plant

Experimental Kiln Features Brick Plant

Continuous testing and research are essential to success in the maintenance of high standards of refractoriness, in the development of new products and as a check on quality. The accompanying illustration shows a diminutive but effective kiln for experimental purposes in a Californian refractory-brick plant. This is used for trial burnings and for the testing of the finished product from the beehive kilns alongside.

Glass Pump Plungers Lessen Replacements

By D. S. Chamberlin
Assoc. Prof. of Industrial Chemistry
Lehigh University, Bethlehem, Pa.

In pumps used for handling mine waters, corrosive liquids, or waters containing grit, one of the parts showing the greatest wear is the plunger. As practically all metals and alloys that can be used for this purpose are attacked by acids and are scored by grit, the glass plunger is suggested as a remedy for the constant replacement now necessary in many operations.

Several disadvantages are found in connection with the use of porcelain cylinders that are now employed to a considerable extent for pump plungers. Notwithstanding the fact that such plungers are acid resisting and very hard, their cost is high, time of delivery is uncertain, the walls are fragile, they require machining to be fitted and, worst of all, their coefficient of expansion is low when compared to that of the steel rod and the embedding material with which they must be used.

Glass cylinders, on the other hand, are acid resistant, very smooth, and very hard; their cost is from ¼ to ⅓ that of porcelain; they can be blown in an iron split mold to exact diameter and length; and the coefficient of expansion is very close to that of steel and neat cement.

A limited experience has convinced the writer that glass as a material in pump construction only requires care-

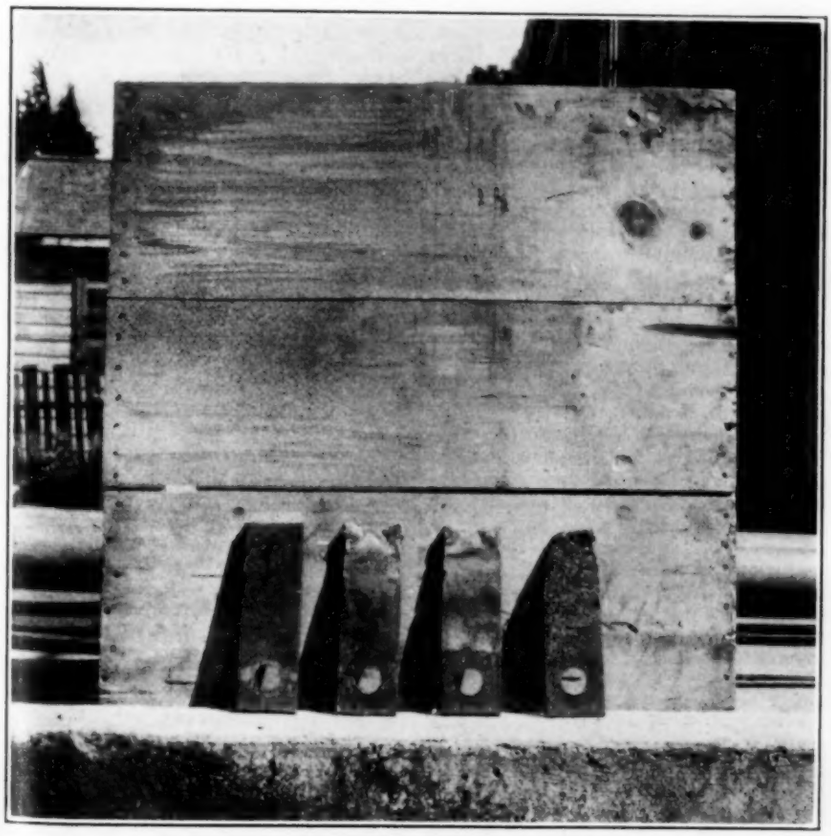
ful development by pump manufacturers to solve many of the problems with which the operator is now afflicted in the replacement of plungers, valves and valve seats.

Reducing Replacement Delays With Hammer Mills

The Mason Byproducts Co., of Sausalito, Calif., uses Williams swing-hammer mills of the type known as the "Miller's Special" for crushing raisins. Because of the large amount of fine sand in the feed, the life of ordinary steel hammers was but 18 hours. The expense of renewing these hammers is a minor item; but the lost time incident to renewal (considering the 100 ton daily output of the machine) is of more importance and, in fact, is extremely costly.

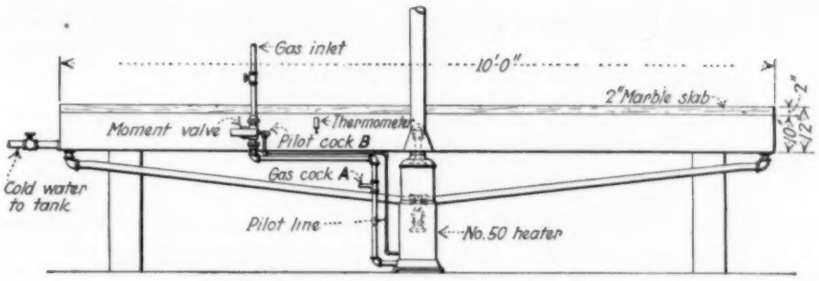
In order to avoid this lost time to the greatest possible extent, new tips of "stellite" are welded to the worn hammers. This serves to increase the life of the hammer, between renewals, to 84 hours. Better output over a given period is also secured, because the blade with the "stellite" tip retains a satisfactory cutting edge over a longer period.

The accompanying halftone shows several of the hammers. That on the left is an unused steel hammer, while that on the right is a steel hammer worn down after some hours' service. The two hammers in the middle have had "stellite" tips welded on, but have not as yet been ground to dimensions for service.



Hammer Mill Blades

Contrast between new hammer, used hammer and hammers repaired with welded-on "stellite" tips, for use in Williams hammer mill.



Temperature Controlling System for Water Bath Below Mirror Slab

Automatic Heat Control in Mirror Manufacture

A customary method of "silvering" glass, for the production of a mirror surface, is to flood it with a solution of silver nitrate and sodium-potassium tartrate (Rochelle salt). This is then allowed to dry by slow evaporation, whereby the precipitated silver adheres to the glass. The back is then given a coat of protective paint or varnish.

The plates of glass are usually placed on a moistened carpet that covers a slab of marble, which forms the top of a water bath. The maintenance of precise temperature in the bath is important, however; and this has been secured at the plant of the Golden Gate Glass Co., San Francisco, by utilizing a No. 50 Rudd gas heater and moment valve, connected as illustrated herewith. The water pan is 10 ft. long, 6 ft. wide and 10 in. deep. The temperature of the water is maintained at 150 deg. Fahr.

One Way to Save Oil Slopped on Floors

Plants handling vegetable and animal oils in barrels are troubled with losses that occur where these barrels are handled at points such as the melting room. If such points are provided with drains leading to a settling tank and the floors are washed at frequent intervals with hot water, sufficient oil will be recovered to pay for the operation and, in addition, the floors will be kept in a much less messy condition.

Testing Tanks With a Grease Gun

Often when a riveted tank is constructed in the field, the facilities for testing are limited and it is difficult to determine whether or not any of the rivets leak. *National Petroleum News* recently told of a simple method devised by B. G. Morland of the Kluver-Morland Construction Co., Houston, Texas, in connection with the erection of oil tanks. He had an Alemite bayonet connection fitted into a threaded nipple of a size to fit the rivet hole. The bottom rivet of each seam was chiseled out, the hole tapped and this connection screwed in. An Alemite gun, filled with red lead instead of grease, was attached and the gun started. As long as the rivets are tight, the red lead is forced up through the narrow space between the plates. Where a leaky rivet occurs, the lead forces its way out around it and shows on the outside.

Corroded Structures Increase Tornado Damage

The disastrous tornado that crossed southern Illinois not long ago served to bring out many facts concerning industrial structures which, if thoroughly digested and taken to heart, should do much to reduce future damages.

One of the most important things made evident was that many steel structures which had originally been strong enough to withstand the storm were so weakened by corrosion that they failed completely. Here is one of the most effective arguments for eternal vigilance in the maintenance of exposed steel. Although the central part of the country seems most liable to such destructive storms, no part of the United States is entirely immune and the possibility of total loss which may follow any carelessness in fighting such corrosion should cause those responsible to redouble their efforts to avoid it.

New Engineering Equipment Marks Tenth Chemical Show

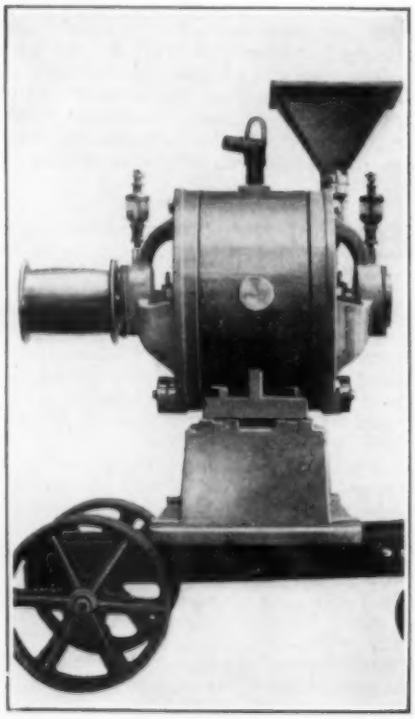
Recent Exposition in New York Introduced Many Devices Helpful to the Chemical Engineer

Editorial Staff Report

THE Tenth National Exposition of the Chemical Industries, held in New York City from Sept. 28 to Oct. 3, 1925, proved again that there is no other thing so helpful in keeping the chemical engineer abreast of progress in chemical engineering equipment as such exhibitions. The latest in primary equipment, control devices and auxiliaries, gathered there in one place made it an easy task to ascertain in a short time what the latest equipment used in each particular industry is; and at the same time to make a rapid survey of the progress achieved in other industries.

A feature of this exposition which greatly aided the engineer in getting the most out of it was the restriction of attendance during the afternoon sessions to technical men or others who, through the work in which they are engaged, are legitimately interested in the chemical engineering industries. This assured the visitor an ample opportunity to inspect the exhibits and to discuss his problems at length with those whose equipment proved of interest.

The equipment shown, while not all-inclusive, still was broad enough to cover the needs of almost any industry. Much of this equipment had been shown before and, in many cases where there were improvements, these were in the nature of refinements, such as a change in driving methods or an improved type of bearings.



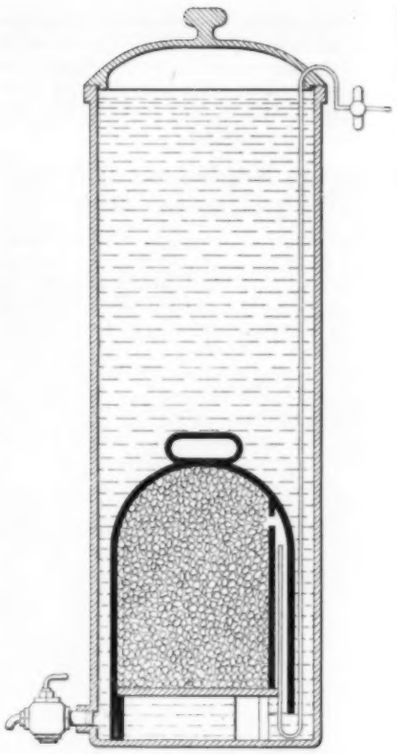
Mill for Making Suspensions and Emulsions

However, more than the usual quota of novelties appeared at this show. For instance, The Miller Rubber Co. of New York, Akron, Ohio, exhibited the application of their vulcanized rubber lining to metal drums and small wooden containers. This lining was formerly applied only to tank cars and large sizes of storage tanks. With the introduction of the above mentioned line, they have now available a full line of containers for the shipment and storage of acids.

A similar line of rubber-lined acid containers was also exhibited by the United States Rubber Co., who have recently developed and applied an acid-proof rubber lining of their own.

Continuous filtering has held the attention of chemical engineers for some time past and as a natural result of this interest, new equipment of this type is now being brought out. For instance, the Laughlin Filter Corporation, 120 Broadway, New York City, showed for the first time a continuous filter. This filter is centrifugal in action and operates at low speeds, from 400 to 800 r.p.m. The horsepower, when running empty, is about 6 for the 24 inch size. The filter consists of a bowl in 2 sections, in one section of which the solids are precipitated on the periphery. They are then removed to the second section, from which they are discharged by a differential arm mechanism, the liquid portion passing back to the first section and discharging separately. The filter is primarily intended for use with any material which readily separates on standing. With such material, complete separations can be obtained. Where a large amount of comparatively dry solids is desired, this filter should follow a thickener and its liquid discharge should be returned to the thickener for clarification. Capacity is from 2½ to 5 tons of dry solid discharge per 24 hours per horse-power input.

Another continuous filter is the "Auto" filter, shown by the Suchar Process Corporation, 50 Broad St., New York City. This filter has had 4 years' successful operation in the sugar industry and is now put forward for the first time for general use. It is of the pressure leaf type, designed for rapid separation of relatively small concentrations of suspended solids in liquids. Continuous rotation of the leaves insures uniform cake formation. Visible discharge from each leaf through sight glasses makes it possible to cut out defective leaves without interruption of the cycle. There is also provided a sluicing device that cleans the leaves and removes the cake without opening of the casing. There are 5 standard sizes, from 100 to 1,000 sq.ft. of filtering area, with leaf spacings of 2½ and 3 in.



Sectional Layout of New Automatic Gas Generator for Hydrogen Sulphide and Other Gases

Among the new grinding mills shown was the "Harosh" mill, a machine for grinding dry products from ¼ in. to 100 mesh or finer. This mill is of the swing-hammer type, with special steel hammers having a cutting edge. It is so designed that these hammers actually cut the material that is being ground to the requisite degree of fineness, instead of crushing it. This is of particular value in handling material like diatomite, where it is desired not to destroy the original structure. The mills are made in several sizes having capacities from 200 to 4,000 lb. per hour and are said to save about 25 per cent power consumption when compared to other types of mills of the same capacity.

Gruendler Patent Crusher & Pulverizer Co., St. Louis, Mo., had a new type of high speed hammer mill in a laboratory size which is also to be produced in large sizes. This mill runs at 3,400 r.p.m. All joints are welded and special copper gaskets and dust-proof bearings are used, so that the mill is dust proof. A positive screw feeder is supplied. Fineness is controlled by the use of monel metal screens from ¼ to 120 mesh. This mill is for all general disintegrating work except on abrasives; and on soft materials it will grind to 75 or 80 per cent through a 200 mesh screen.

Much attention has been given in recent years to the development of a successful method of chromium plating. The value of chromium due to its hardness and resistance to corrosion is well-recognized and the attempt has been made to obtain these qualities for less valuable metals such as steel by means of a chromium coating. This process has been perfected in several

quarters recently, as noted elsewhere in *Chem. & Met.* At the show, pure chromium p'ating on all sorts of utensils and equipment was shown by the Metal & Thermit Corporation, 120 Broadway, New York City and a chromium alloy plating, having almost the hardness of chromium and resistance to certain acids that pure chromium will not withstand, called "Crodon," was shown by the Chemical Treatment Co., Inc., 26 Broadway, New York City.

The Barco Mfg. Co., 1801 Winnemac Ave., Chicago, Ill., exhibited a new lubricated plug valve using "Alemite" pressure lubrication. In this valve, the plug is held in the seat either by a spring or by pressure from the liquid being handled. The amount of force required to turn the valve is easily controlled by tightening or loosening the gland, for the taper is toward the gland, and the valve can thus be adapted to any pressure it is required to handle. This valve is made in materials to withstand any type of corrosive service and for temperatures up to 1,100 deg. F.

The same company also exhibited for the first time in the chemical engineering field a ball joint that has been widely adopted in railroad work for several years. This flexible point is for use wherever a flexible joint is needed to replace service now done by hose and is said to withstand high pressures and temperatures and also is made of corrosion resistant materials.

A climbing film evaporator, having 3 effects superimposed in one column was shown by the J. P. Devine Co., Buffalo, N. Y. This evaporator is called the "Improved Lawrence" type and revives the original idea of Pecqueur for consolidating several effects within one body. The result is the elimination of a large amount of external piping that in the usual designs is a source of serious heat losses. This evaporator will not function as a salting-out machine, because the final effect is at the top of the column. However, it is particularly applicable to the concentration of thermally sensitive materials, it being claimed that the time of one through-put of liquor is but 2 minutes.

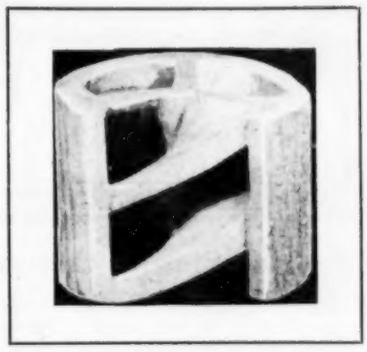
Buffalo Foundry & Machine Co., Buffalo, N. Y., exhibited a new distilled water evaporator designed for the economical production of pure distilled water in large quantities for industrial purposes. These evaporators are built in single and multiple effect units with capacities from 72 to 2,000 gallons of distilled water per hour.

A new mill for making emulsions and suspensions was exhibited by the National Homogenizer Co., 119 Broad St., New York City. This is the mill developed some time ago in England where it is known as the "Hurrell" homogenizer. It is used with mixture of liquids, semi-liquids, or liquids carrying solids in suspension. These materials are caused to pass between 2 closely related surfaces, one fixed and the other rotating at high speed. By taking advantage of the tendency of the material being treated to remain in the gap, an automatic regulation of the quality of output is obtained by regulating the amount of delivery to the machine, the smaller the delivery the longer the time of treatment which the material undergoes.

The Glascote Co., Euclid, Ohio, had a new departure in a glass-lined, steam-jacketed, open, steel evaporating kettle with a glass-covered agitator. These kettles are now available in sizes from 50 to 200 gal.

Maurice A. Knight, Inc., Akron, Ohio, manufacturer of acid proof stoneware, showed a new gas generator for producing hydrogen sulphide and other gases called the "Annis-Knight" automatic gas generator. This device, designed to take the place of the glass generators now used, is made entirely of acid proof stoneware, except for the use of one glass tube. Its construction is evident from the accompanying cut. It is said to have 4 times the capacity of any other generator of the same size. This company also exhibited stoneware pipe in lengths up to 20 ft. and stoneware ventilating ducts for acid fumes, both of which are new developments.

C. O. Bartlett & Snow Co., Cleveland, Ohio, has recently acquired the American rights to the "Fusion" rotary machine, which is used for drying, carbonizing coals and shales, and mixing. They are at present putting this device forward on the American market as a drier. As used for carbonizing purposes this machine has already been described at length in *Chem. & Met.* for Oct. 22, 1923. The machine when used as a drier is essentially the same, comprising a steel tube which is caused to rotate and within which is placed a breaker, consisting of a shaft upon which are mounted radial blades with edges parallel to the axis of the shaft. This breaker is free to tumble as the tube rotates. Its overall length is but slightly less than that of the tube and its outside circumference is much less than the circumference of the tube. The material to be dried is placed within the tube and hot, inert gas or heated air is led through it. The dryer is recommended by the makers for such materials as sludges, slurries, sewage, clays, etc.



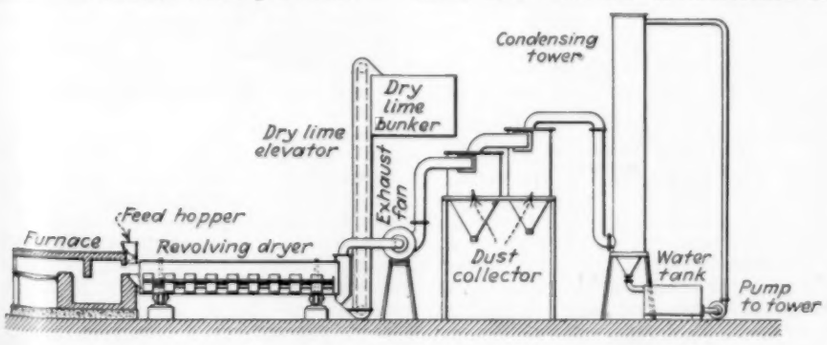
Section of Novel Acid-Proof Stoneware Tower Packing

An interesting new tower packing was shown by Chemical Appliances, Inc. This packing is of acid-proof stoneware and has three spiral paths through it, thus providing a large surface for contact. The hole usually found leading directly through such packing on its axis is lacking, which is said to be advantageous in making all the fluids passing through the tower take the spiral paths.

This company has also combined the acid-resistant radial stack brick made by the Alphons Custodis Chimney Construction Co. with the acid-proof cement made by the Quigley Furnace Specialties Co., and are prepared to construct towers and other structures from these materials. An example of this construction was shown at their booth. They are also marketing a new design of automatic feeder for nitrate of soda.

C. M. Kemp Mfg. Co., Baltimore, Md., exhibited a system for premixing fuel gas with any desired amount of air. With this system an oxidizing or reducing furnace atmosphere can be produced, or exactly the correct amount of air may be used to give perfect combustion. It is also possible to burn the gas with this system in an enclosure containing an atmosphere which will not support combustion, such as steam or a gas containing no oxygen. This system has been applied in destructive distillation, where the absence of oxygen prevents the combustion of the material being heated. It has also been applied to many types of ovens and furnaces. The manufacturers claim that the use of this system will prove economical in almost any chemical industry.

The Thermo Electric Instrument Co., Newark, N. J., brought out a new device for artificially aging rubber, the "Freas" rubber aging bath. This bath is equipped for use with the oxygen bomb and is a tinned copper tank 16½ in. in diameter and 16½ in. deep, having hair felt insulation and a leaded Armco outside wall. The base is cast iron, with 2 in. legs. It is equipped with G. E. immersion heaters, condulet wiring, motor stirrer and "Freas" regulator.



Layout of "Fusion" Rotary Dryer Plant in Which Direct Heating Is Used

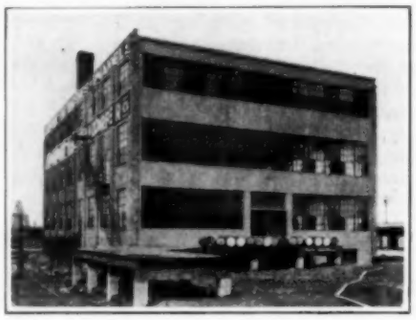
Equipment News

From Maker and User

Underflow Density Control

A device which automatically controls the density in any type of underflow thickener or apparatus from which settled solids may be withdrawn continuously has been developed by W. A. Bradley and is being marketed by the Thyle Machinery Co., San Francisco, Calif. The essential equipment consists of an auxiliary chamber, of small volume, of the shape shown in the accompanying illustration. Immediately below the connection to the thickener or other apparatus is a rubber sleeve, and just above the exit pipe is a second rubber sleeve. The regulator chamber, supported by a shiftable weight on a lever arm and fulcrum, is free to move to a limited extent in an upward or downward direction. In the lower part of the chamber is a bridge, to which is cast the upper end of a stem connecting with a cone valve, seating in an extension of the framework connecting with the main apparatus and therefore rigid.

The weight on the lever arm is first adjusted according to the density of product desired. Operation is thereafter automatic. Increased weight, corresponding to increased density, of the auxiliary chamber results in a downward movement of the chamber and valve, which is thereby opened and equilibrium established. Decreased weight, corresponding to decreased density, results in an upward movement, and the restriction of the discharge opening.

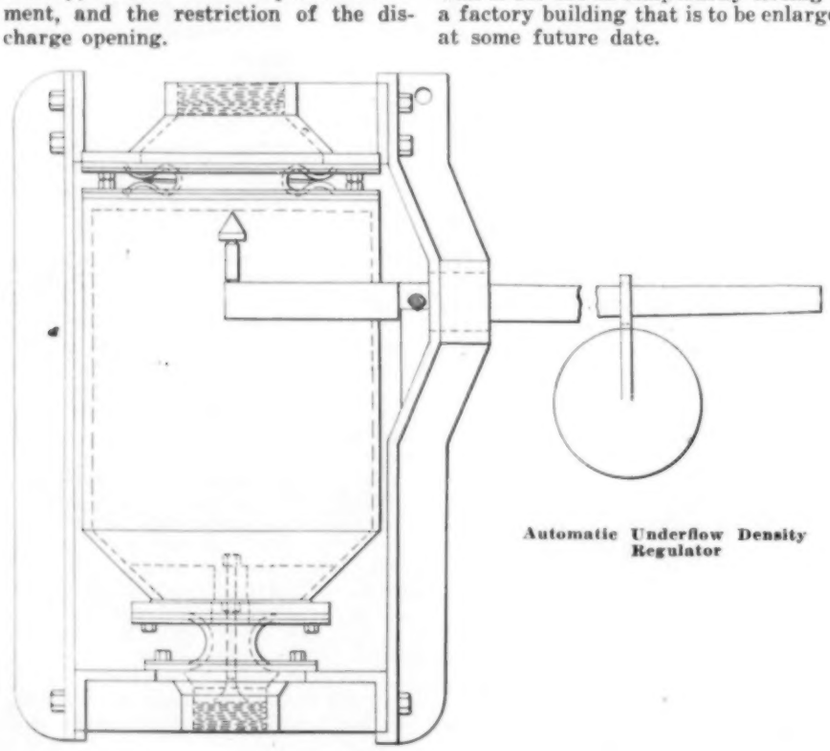


Temporary Steel Wall for Factory

This device, it is claimed, will find wide application in the chemical engineering industries, particularly for the regulation of density of thickener underflow going to vacuum or pressure filters, or for the automatic control of underflow from units comprising a countercurrent decantation system. It is also available for the separation of liquids of different specific gravities; and, in a modified form, for the automatic discharge of crystals from evaporation and refrigeration apparatus.

Temporary Wall

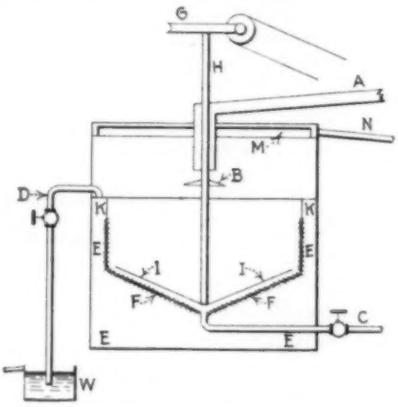
The accompanying illustration shows a factory end wall made from "Pullman Steel Siding," a heavy steel plate wall structure developed by the Austin Co., Cleveland, Ohio. This type of wall is for use in temporarily closing in a factory building that is to be enlarged at some future date.



Automatic Underflow Density Regulator

Thickener-Filter

A new type of thickener-filter, devised by A. H. Godbe and being developed by the Southwestern Engineering Corporation, Los Angeles, Calif., combines gravitational settlement with filtration under slight pressure on the bottom and sides of the apparatus. Referring to the accompanying sketch the essential equipment is a pulp-intake launder (*A*) delivering against a pulp distributor (*B*) into a tank equipped with a false sloping bottom and sides, forming an open and a closed section. The open section is similar to an ordinary thickener, with vertical shaft (*H*), drive (*G*) and plough arms (*I*).



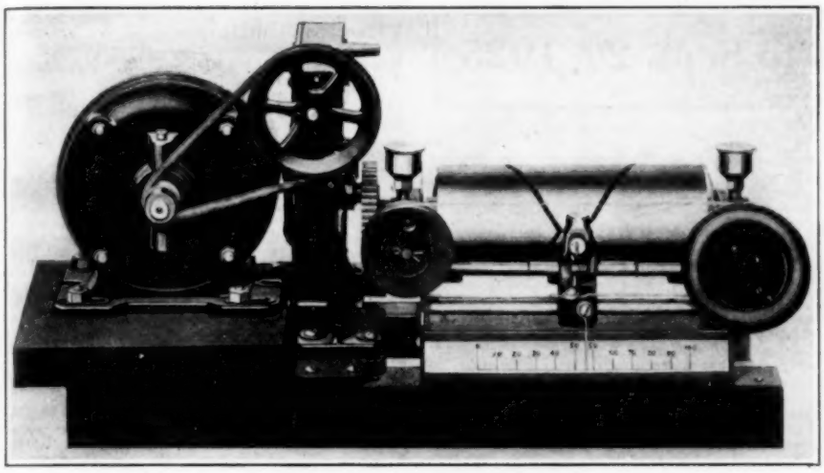
Godbe Thickener-Filter

The medium between the open and closed section (*F*) however, consists of a pervious material, the closed chamber being connected with a leg of piping (*D*) that discharges into a constant-head overflow reservoir (*W*), whereby a slight pressure is maintained on the filtering surface. At regular intervals an automatic arrangement provides a slight back pressure in the chamber (*E*), whereby the cake formed on (*F*) is dislodged, and, together with the material settled by gravity, is swept toward the thickened-pulp discharge (*C*). An annular overflow for supernatant liquid is provided at (*M*), with the collected discharge through launder (*N*).

Adjustable Speed Drive

A drive unit that makes possible the use of an alternating current motor on service where adjustable speed is a necessity has recently been brought out by the Louis Allis Co., Milwaukee, Wis. This device, known as the Allis Adjustable Delivery Motor Drive, is shown herewith. It is said to give an infinite number of speeds applicable to constant average speed requirements.

The drive consists of the three units:



Adjustable Delivery Motor Drive

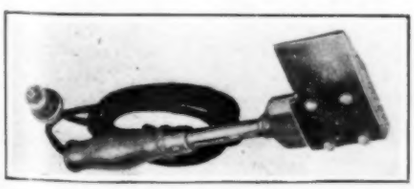
an L-A Multi-Speed A. C. Motor, a revolving drum for establishing the average speed, and contactors for switching the motor. The motor, a fractional horsepower machine, revolves the selector switch drum at 1 or 2 r.p.m. By changing the position of a movable brush, a 2 speed motor, for instance, can be made to run all the time on the low speed, all the time on the high speed, or any desired portion of time on the high and low speeds. By choosing a motor the high speed of which is faster than it is ever desired to run and the low speed lower than it is ever desired to run, an infinite number of steps can be obtained.

This drive is said to be particularly adapted for use with stokers, conveyors, traveling ovens and similar equipment where a constant average speed that may be infinitely varied is desired.

Soldering Iron

A wide tip soldering iron has been placed on the market by Harold E. Trent, 259 N. Lawrence St., Philadelphia, Pa. This iron is designed to meet the requirements of heavy work. It is made in 2 styles, "spear" and "hatchet," as shown in the accompanying picture. This iron has a copper tip in which the heating unit is clamped and which can be left on indefinitely at its rated voltage without overheating the tip or burning out the unit.

The iron complete weighs 5¼ lb. The tip is 3 in. wide by ¼ in. on its working surface. The wattage is 500 at 110 volts.



Wide Tip Soldering Irons of "Spear" and "Hatchet" Types

Chart Hub and Cap for Recording Instruments

Improved Chart Hub

An improved chart hub for recording instruments, shown in the accompanying photograph has been brought out by The Foxboro Co., Foxboro, Mass. This hub is designed so that it cannot pinch and the chart cannot be placed in any other position than the true center. Charts may be placed and then adjusted for true time without removing the cap.

This hub is constructed with a flat steel spring and one ball. A channel cut in the hub cap simplifies fitting the cap. No twisting is necessary in placing cap. Three pins in the contact face of the cap grip the chart paper so that turning the cap also turns the chart, permitting time adjustment.

Centering is secured by cutting a collar into the hub, over which the chart rides. The cap is undercut to enclose the collar edge and thus hold the chart securely in place.

Refractory Brick

After several years of experimental work and of tests in such plants as the Atwater Street power plant of the Detroit Public Lighting Commission, the Jonathan Bartley Crucible Co., Trenton, N. J., has placed on the market their new refractory brick "Lawtonite."

This refractory has been developed as a lining for coal, oil or gas fired and electric heated furnaces such as are used in the ceramic, glass, enameling, gas and metallurgical industries. The fusion point is from 3,100 to 3,200 deg. F. Load tests at 2,462 deg. F., with the test pieces loaded at 25 lb. per sq. in. for 1½ hours, show a shrinkage averaging 0.2 per cent.

It is claimed by the makers of this refractory that its use results in considerable saving of furnace lining expense and that it also results in increased output and better operating conditions. These benefits are said to flow from the longer life of this refractory under severe operating conditions.

Manufacturers' Latest Publications

Republic Flow Meters Co., 2240 Diversey Parkway, Chicago, Ill.—Circular describing the electrical level and pressure indicator and recorder for reservoirs.

Caterpillar Tractor Co., San Leandro, Calif.—Folder describing full line of tractors now made by this company and formerly made by C. L. Best Tractor Co. and Holt Mfg. Co.

Advance Machinery & Supply Co., Denver, Colo.—Folder describing the Advance Stoker, for firing industrial plant boilers and furnaces.

Gilbert & Nash Co., Menasha, Wis.—A folder describing wire and felt guides for paper machines.

Uehling Instrument Co., Paterson, N. J.—Bulletin No. 140.—A catalog describing the new Type "D" vacuum recorder.

Louis Allis Co., Milwaukee, Wis.—Catalog of the Allis adjustable delivery motor drive for alternating current.

U. S. Electrical Mfg. Co., Los Angeles, Calif.—Folder describing the self-starting motor made by this company.

Industrial Chemical Co., 200 Fifth Ave., New York, N. Y.—Booklet describing "Nuchar" Activated Carbons as used in the oil refining industry.

Colorado Iron Works Co., Denver, Colo.—A pamphlet describing this company's manufacturing facilities.

Jonathan Bartley Crucible Co., Trenton, N. J.—A catalog describing the use of graphite crucibles in foundries.

Denver Fire Clay Co., Denver, Colo.—A folder describing oil burners for various industrial purposes.

Engberg's Electric & Mechanical Works, St. Joseph, Mich.—Catalogs Nos. 600 and 800—The first of these deals with direct current generators and motors and the second with alternating current generating sets.

H. H. Robertson Co., Pittsburgh, Pa.—The "Ventilation Data Book," a catalog of ventilators and their use, giving specifications and installation information.

Foote Bros. Gear & Machine Co., 203 N. Curtis St., Chicago, Ill.—A folder on the uses of geared speed reducers.

The Chemical Rubber Co., Cleveland, Ohio.—A booklet describing the Warner and Swasey metallographic polishing machine, distributed by this company.

Warner Elevator Mfg. Co., Cincinnati, Ohio—Folder on the "Type F-18" electric dumbwaiter for industrial plants.

Merco Nordstrom Valve Co., 121 Second St., San Francisco, Calif.—Catalog of Merco Nordstrom plug valves for chemical plants and general industrial use.

Patents Issued Sept. 8 to Sept. 29, 1925

Paper, Pulp and Sugar

Paper-Making Machine. Ralph Swan Clarke, Walpole, Mass., assignor to Bird Machine Company.—1,552,594.

Method of Manufacturing Paper Pulp. Victor Bernot and Pierre Raymond Fournier, Boulogne-Seine, France, assignors to Société "La Paille Industrielle," Noyon, France.—1,553,976.

Method and Apparatus for Drying Paper. Hugo H. Hanson, Boston, Mass., assignor to Eastern Manufacturing Company, Boston, Mass.—1,553,443.

Beater Roll. Walter Werner, Hoosick Falls, N. Y., assignor to The Noble & Wood Machine Co., Hoosick Falls, N. Y.—1,552,658.

Process of Deinking Paper. Emil Kellner, Kalamazoo, Mich.—1,555,674.

Process of Utilizing Waste Gases from the Cookers in Cellulose Industry. Hanns Koch, Frankfort-on-the-Main, Germany, assignor to International Precipitation Company, Los Angeles, Calif.—1,554,581.

Process for Utilizing the Water from Pulp Presses and the Residual Water Produced by the Extraction of the Juices in the Beetroot-Sugar Industry. Gaston Albert Duret, Paris, France.—1,552,737.

Manufacture of Starch. Robert F. Sherman, Pekin, Ill.—1,554,301.

Starch. Paul W. Allen, Cedar Rapids, Iowa, assignor, by mesne assignments, to Penick & Ford, Ltd., Incorporated.—1,554,699.

Rubber and Synthetic Plastics

Process of Vulcanizing Rubber. Egidio Romani, Turin, Italy, assignor to Ernest Smith, Turin, Italy.—1,555,256.

Process for Preparing Rubber-Containing Plastics and Products Obtained Thereby. John McGavack, Elmhurst, N. Y., assignor to Revere Rubber Company, Chelsea, Mass.—1,555,131.

Process for Vulcanizing Rubber and Similar Materials and Products Obtained Thereby. Sidney M. Cadwell, Leonia, N. J., assignor to The Naugatuck Chemical Company, Naugatuck, Conn.—1,552,820.

Process of Making Molded Fiber Articles. Chauncey C. Loomis, Yonkers, and Horace E. Stump, Brooklyn, N. Y., assignors, by mesne assignments, to The Hevea Corporation.—1,552,625.

Process of Separating the Constituent Materials of Fibrous Thermoplastic Stock. Henry P. Shopneck, Dorchester, Mass.—1,555,763.

Petroleum Refining

Art of Cracking Hydrocarbons. Edward W. Isom, Locust Valley, N. Y., assignor to Sinclair Refining Company, Chicago, Ill.—1,553,168.

Apparatus for Cracking or Converting Oils. Otto P. Amend, New York, N. Y., assignor to Hydrocarbon Corporation, New York, N. Y.—1,553,300.

Art of Forming Low-Boiling-Point Hydrocarbons. Robert E. Humphreys, Francis M. Rogers, and Max G. Paulus, Whiting, Ind., assignors to Standard Oil Company, Chicago, Ill.—1,553,861.

Process for Oil Refining. John McK. Ballou, Los Angeles, Calif.—1,553,973.

Fluxing Oil. William M. Burton, Chicago, Ill., assignor to Standard Oil Company, Chicago, Ill.—1,553,847.

Still for Hydrocarbon Distillation. Francis M. Hess, Whiting, Ind.—1,552,698.

Oil Purification. Lee H. Clark, Rosemont, Pa., assignor to The Sharples Specialty Company, Philadelphia, Pa.—1,553,141.

Refining of Liquid Hydrocarbons. Albert Ernest Dunstan, Sunbury on Thames, England.—1,552,830.

System for the Recovery of Mineral Oils. Walter A. Loomis, Los Angeles, Calif.—1,554,444.

Process and Apparatus for Separating Water and Impurities from Hydrocarbons, Soaps, Fats, and the Like. Moyle S. Skaer, Augusta, Kans.—1,555,231.

Combustion and Furnaces

Fuel Briquettes and Process of Making the Same. William Prescott, London, and Douglas Fitzgerald Worger, Banstead, England, assignors to Prescer Briquette Company, Limited, London, England.—1,554,462.

Apparatus for Treatment of Peat Mass and Production of Peat Fuel. Eduard Peter-Theodor Reinholdowitsch Ulmann, Viborg, Finland, assignor to the Firm Aktieselskabet Hydropeat, Copenhagen, Denmark.—1,554,472.

Apparatus for Manufacture of Water Gas. Paul Dvorkovitz, North Kensington, London, England.—1,554,073.

Reversing Apparatus for Regenerative Furnaces. George H. Isley, Worcester, Mass., assignor to Morgan Construction Company, Worcester, Mass.—1,553,242.

Heating Furnace. William H. Fitch, Allentown, Pa.—1,552,834.

Coking-Retort Oven. Joseph Becker, Pittsburgh, Pa., assignor to The Koppers Company, Pittsburgh, Pa.—1,553,662.

Coking Process and Product. Frederick W. Sperr, Jr., Pittsburgh, Pa., assignor to The Koppers Company, Pittsburgh, Pa.—1,553,641.

Distillation of Coal and Other Carbonaceous Substances. Thomas Malcolm Davidson and Harold Lavers Armstrong, London, England.—1,552,471.

Coke Oven. Parasco Alidjiadis, New York, N. Y.—1,553,795.

Refractory Brick. Walter Crow and John C. Schaffer, Pittsburgh, Pa., assignors to Schaffer Poidometer Company, Pittsburgh, Pa.—1,553,143.

Composite Refractory Body. John Wesley Marden, East Orange, and Henry Kneeland Richardson, Newark, N. J., assignors to Westinghouse Lamp Company.—1,554,225.

Inorganic Processes

Method of Manufacturing Basic-Lead Sulphate. Bernard S. White, Joplin, Mo., assignor to The Eagle-Picher Lead Company, Cincinnati, Ohio.—1,555,538.

Method and Apparatus for Manufacturing Basic-Lead-Sulphate Pigment. John A. Schaeffer, St. Louis, and John H. Calbeck and Bernard S. White, Joplin, Mo., assignors to The Eagle-Picher Lead Company, Cincinnati, Ohio.—1,555,520.

Process of Obtaining Arsenic Acid from Metallic Arsenates. Charles G. Richardson, Elizabeth, N. J.—1,554,371.

Process of Making Cement. Edwin C. Eckel, Washington, D. C.—1,555,405.

Process of Making Cement Clinker. Charles B. Hillhouse, New York, N. Y.—1,555,283.

Production of Quick-Setting Lime Products by the Addition of an Aluminum Fluoride. Major E. Holmes and Gail J. Fink, Washington, D. C., assignors to National Lime Association, Washington, D. C.—1,554,183.

Method for Recovering and Purifying Radium Compounds. George O. Williams, Denver, Colo.—1,554,056.

Manufacture of Catalytic Materials. Alfred T. Larson, Washington, D. C., assignor to Richard C. Tolman, trustee.—1,554,008.

Catalysts and Process of Producing the Same. Alfred T. Larson, Washington, D. C.—1,555,505.

Process of Purifying Argon and Preparing Oxidized Products. Pierre E. Haynes, Buffalo, N. Y., assignor to The Linde Air Products Company.—1,555,570.

Organic Processes

Process for Making Acetic Aldehyde. Carl Stuart Williams, Woodbridge, N. J., assignor to The Roessler & Hasslacher Chemical Co., New York, N. Y.—1,555,539.

Manufacture of Metaldehyde. Emil Lüscher and Theodor Lichtenhahn, Basel, Switzerland, assignors to Elektrizitätswerk Lonza, Basel, Switzerland.—1,555,223.

Process for Making Homologues of Styrol from Aromatic Hydrocarbons. Iwan Ostromislensky and Morris G. Shepard, New York, N. Y., assignors to The Naugatuck Chemical Company, Naugatuck, Conn.—1,552,874.

Process for Obtaining Amino-Benzoyl Derivatives of 2-Methyl-4-Diethyl-Amino-Pentanol-5 and 2-Methyl-4-Dimethyl-Amino-Pentanol-5. Paul Karber, Zurich, Switzerland, assignor to Chemical Works Flora, Dubendorf, near Zurich, Switzerland.—1,555,217.

4-Hydroxynaphthalene-1-Arylketones and Process of Making Such Products. Guillaume de Montmollin, Emil Reber, Gérald Bonhôte, and Josef Spieler, Basel, Switzerland, assignors to Society of Chemical Industry in Basle, Basel, Switzerland.—1,552,472.

Process of Producing a Di-Acet-Oxy-Mercuri-4-Nitro-Ortho-Creosol and the Product Thereof. George W. Raiziss, Philadelphia, Pa., assignor to The Abbott Laboratories, Chicago, Ill.—1,554,292.

Compound of Halogen Acids with 2-Phenol-6-Methyl Quinoline 4-Carboxylic Acid and Esters Thereof. Harley W. Rhode-Hamel and Elmer H. Stuart, Indianapolis, Ind.—1,552,568.

Butyl Esters of Phthalic Acid. Ebenezer Emmet Reid, Baltimore, Md., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,554,032.

Process of Making Chlorosulphonic Acid. Ralph H. McKee and Carroll M. Sails, New York, N. Y.—1,554,870.

Isopropyl Aromatic Amine. Hyym E. Buc, Roselle, N. J., assignor to Standard Development Company.—1,555,451.

Manufacture of Sodium Formate from Carbon Monoxide. Max Enderli, Oestrich, Germany, assignor to Rudolph Koepp & Co., Oestrich, Germany.—1,555,796.

Preparation of Phenyl Rosinduline Dyes. André Wahl, Enghien, and Robert Lantz, Paris, France, assignors of one-half to Societe Anonyme des Matieres Colorantes et Produits Chimiques de Saint-Denis, Paris, France.—1,555,535.

Preparation of Isopropyl-Para-Aminophenol. Hyym E. Buc, Roselle, N. J., assignor to Standard Development Company.—1,555,452.

Manufacture of New Lignone Derivatives. Charles Frederick Cross, London, England.—1,553,220.

Process for Manufacturing Cellulosic Esters. Paul Berthon, Lyon, France, assignor to La Société de Stearinerie et Savonnerie de Lyon, Lyon, France.—1,553,924.

Cellulose-Ether Composition. Stewart J. Carroll, Rochester, N. Y., assignor to Eastman Kodak Company, Rochester, N. Y.—1,552,792.

Cellulose-Ether Composition. John M. Donohue, Rochester, N. Y., assignor to Eastman Kodak Company, Rochester, N. Y.—1,552,798.

Cellulosic Composition. Ebenezer Emmet Reid, Baltimore, Md., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,554,033.

Process for Reducing the Viscosity of Nitrocellulose Solutions. Gilbert C. Bacon, Stamford, Conn., assignor to Atlas Powder Company, Wilmington, Del.—1,553,494.

Process for Washing Artificial Silk. Hermann Lummerzheim, Wolfen, Germany, assignor to Actien Gesellschaft für Anilin Fabrikation, Berlin, Germany.—1,553,252.

Electrolytic Cells and Processes

Dry Cell. Serge Apostoloff, New York, N. Y.—1,552,414.

Dry Cell. Serge Apostoloff, New York, N. Y.—1,553,658.

Storage Battery. Oscar R. Blatter, Albion, Nebr.—1,553,742.

Battery Element. Junjiro Sato, Highland Park, Mich.—1,555,438.

Container for Granular Depolarizers and Process of Making the Same. George W. Heise and Raymond C. Benner, Bayside, N. Y., assignors to National Carbon Company, Inc.—1,552,851.

Method of Preparing Depolarizing Mixtures. George W. Heise, Bayside, N. Y., assignor to National Carbon Company, Inc.—1,553,530.

Method and Anode for Electro-Deposition of Rust-Resisting Coatings. Christian John Wernlund, Tottenville, N. Y., assignor to The Roessler & Hasslacher Chemical Company, New York, N. Y.—1,555,537.

Apparatus for the Production of Hydrogen and Oxygen. Eugene G. Luening, Chicago, Ill.—1,555,424.

Nickel Anode and Process for Manufacturing the Same. Noak Victor Hybinette, Wilmington, Del.—1,552,609.

Chemical Engineering Equipment

Crushing Apparatus. Jacob M. Scholl and Ernest E. Pfeffer, Milwaukee, Wis., assignors, by mesne assignments, to Allis-Chalmers Manufacturing Company, Milwaukee, Wis.—1,553,333.

Grinding Mill. Alexander J. Roubal, Milwaukee, Wis., assignor, by mesne assignments, to Allis-Chalmers Manufacturing Company, Milwaukee, Wis.—1,553,328.

Screen. Van M. Lipscomb and Horace H. Hooper, Nashville, Tenn.—1,555,128.

Conveying Pulverized Material. Alonzo G. Kinyon, Allentown, Pa., assignor to Fuller-Lehigh Company.—1,553,539.

Filtering Material and Process of Preparing the Same. David T. Day, Washington, D. C.; Elizabeth E. Day executrix of said David T. Day, deceased.—1,555,639.

Dehydrating Apparatus. Cronin M. Burdette, West Chester, Pa., assignor to The Sharples Separator Company, West Chester, Pa.—1,554,330.

Centrifugal Drier. Ernest Erickson, Clairton, and Charles R. Jeffreys, McKeesport, Pa.—1,553,525.

News of the Industry

Muscle Shoals Commission Assembled Oct. 5

Will Remain in Session Until Report to the President Has Been Formulated

All members of the President's Muscle Shoals Commission assembled in Washington, Oct. 5, with the announced intention of remaining in continuous session until its report to the President has been formulated. It was estimated at the offices of the commission that all of the months of October would be required for this purpose.

At its initial session the commission adopted a resolution, by unanimous vote, to the effect that no announcements as to the progress of its work would be made to the press. The intention of the commission immediately was called to the fact that this would run counter to the customary policy of similar commissions. The Harding Coal Commission, for instance, discussed the progress of its work with representatives of the press each Saturday. Another recent commission which maintained the same practice was the Reclamation Commission. The commission promised to take under consideration some revision of its resolution.

McKenzie Formulates Plan

In a long statement given out by Chairman McKenzie just prior to the first session of the commission, he indicated that it was his purpose to work up and have ready a plan of government ownership and operation of the power and nitrate projects, should such a course become necessary.

"Such a plan," he said, "will assure to the people of this country, and especially the farmers, that Nitrate Plant No. 2 shall be operated for fertilizer production and, furthermore, that the power from the Wilson Dam shall be used for the purpose for which it was built, and that purpose was to operate nitrate plants. We had no other purpose in authorizing its construction."

"Loth as I am to have the government engage in business, which private enterprise can carry on effectively, I am unwilling to concede that our government, rich and powerful as it is, must yield submissively to those who do not wish to operate these plants and who will not help with a plan for operating them. They will not be permitted to play the dog-in-the-manger with my consent."

Ferrocyanides Subject To Ad Valorem Duty

According to a Treasury decision announced last week, calcium ferrocyanide and all other ferrocyanides, cyanates and sulphocyanides or throcyanates will be assessed with duty as chemical salts or compounds not specially provided for under Paragraph 5 of the Tariff Act of 1922 at the rate of 25 per cent ad valorem. A letter from Assistant Secretary Andrews to the Collector of Customs at New York states: "As it is the practice to admit the merchandise free of duty under Paragraph 1565 of the Tariff Act you are directed to continue this practice in respect to all merchandise imported or withdrawn from customs custody within a period of thirty days after the publication of this letter in the weekly Treasury decisions and thereafter to assess duty on the merchandise under Paragraph 5 of the said act."

Import Statistics on Synthetic Organic Chemicals

Extension of the statistical service of the Department of Commerce to include imports of synthetic organical chemicals of non-coal tar origin is one of the achievements of the Chemical Advisory Committee. The committee, in May, pointed out the necessity for these and other import figures to Secretary Hoover. He promised at that time to have the work undertaken just as soon as funds for the purpose could be found.

The gathering of these new figures is a step toward current figures covering all chemical imports not only at New York, but at other ports as well. This will have to be a gradual process. No order of procedure has been worked out. The commodities that will be covered by the next expansion of this service will depend on the demand from the industries concerned.

National Association of Stearic Acid Manufacturers

The National Association of stearic acid manufacturers has been incorporated under the laws of Ohio, with headquarters at Cincinnati. The new association takes in practically every manufacturer in this country. J. A. Burns is president, R. A. Hale, vice-president, F. F. Jordan, secretary-treasurer. Directors are J. A. Bergnoff, A. J. Will, and A. J. Spieler.

Chemical Equipment Exposition To Be Biennial

The third annual meeting of the Association of Chemical Equipment Manufacturers held in the Hotel McAlpin, New York City, Sept. 30 was featured by an announcement that following the Second Chemical Equipment Exposition in the Cleveland Public Hall, May 10-15 inclusive, 1926, no subsequent equipment exposition would be sponsored by the organization until 1928.

The secretary, Roberts Everett, announced that all physical arrangements for the May, 1926, exposition in Cleveland are completed and leasing of space has progressed satisfactorily.

Completion of a schedule of equipment lectures for Carnegie Institute of Technology, Columbia University and Ohio State University under the joint auspices of the association and the three educational institutions was announced.

G. O. Carter, Linde Air Products Co., was re-elected president; Percy C. Kingsbury, General Ceramics Co., A. B. McKechnie, Parks-Cramer Co. and H. N. Spicer, The Dorr Co. were elected vice-presidents; P. S. Barnes was re-elected treasurer; and T. C. Oliver, Chemical Construction Co. and E. C. Alford, T. Shriver & Co. were elected directors.

Larger Use of Fertilizers on Fall Crops in South

The drouth in the South has hurt the fertilizer industry through the reduction in buying power which results from the heavy losses suffered and because of curtailed operations due to power shortage. On the other hand more than the usual amount of fertilizers are being used for the fall crops. Due to the loss of forage chief reliance is being put in fall oats as a substitute. The crop is being heavily fertilized so as to stimulate its growth and to increase its resistance to frost.

Southern farmers have learned that well nourished plants will withstand more cold than undernourished ones. The cane growers who frequently suffer heavy losses through freezing are particularly interested in the results of recent experiments showing that the presence of certain mineral salts and organic matter in the sap acts as a sort of anti-freeze solution. Immunity to even a few additional degrees of cold would mean a great deal for the growers of cane in the Gulf states.

Aluminum Company Denies Charges of Monopoly

Makes Exhaustive Answer to Complaint Issued By Federal Trade Commission

Under date of July 21, the Federal Trade Commission issued a complaint against the Aluminum Company of America. This complaint was not made public until Sept. 23, when the company filed an answer.

The complaint states that the Aluminum Company of America owns extensive bauxite deposits, from which aluminum ore is secured, in Saline County, Ark., and in British and Dutch Guiana, and also owns or has a controlling interest in bauxite deposits in France and Yugoslavia.

The commission alleges that the respondent is the sole producer of virgin aluminum ingots in the United States, and since March, 1923, has "produced over 95 per cent of the virgin sheet aluminum manufactured in the United States, the present sole competitor in this branch of the industry, the United States Smelting and Refining Company of New Haven, Conn., producing not more than 1 per cent of said virgin sheet aluminum at higher prices for spot delivery."

The commission alleged that the respondent "owns 36 per cent of the stock of the Aluminum Goods Manufacturing Company, the largest manufacturer of aluminum cooking utensils in the United States, and 100 per cent of the stock of the United States Aluminum Company, the second largest manufacturer of cooking utensils in the United States, these two companies producing not less than 65 per cent of the total output of said cooking utensils in the United States; 75 per cent of the stock in the American Body Company, which manufactures aluminum bodies for automobiles; 64 per cent of the stock of the Aluminum Manufacturers, Inc., which makes sand castings for automobile parts; 89 per cent of the stock in the Aluminum Die Castings Corporation; and 80 per cent of the stock of the Aluminum Screw Machine Products Company."

These alleged acts of the company are declared by the Federal Trade Commission to be in violation of section 2 of the act of Oct. 15, 1914, against unlawful restraints and monopolies.

The Aluminum Company of America admits, in its reply, that it is the sole manufacturer in the United States of aluminum ingots, as made from bauxite. The allegation in the complaint that the Aluminum company produces over 95 per cent of the virgin sheet is denied, as is the statement that the United States Smelting and Refining Company is its sole competitor in the manufacture of sheet aluminum.

The Aluminum Company denies that it "has adopted and maintained the practice of entering into contracts or agreements for the sale and is now selling and making contracts for the sale in interstate commerce of virgin sheet aluminum to manufacturing foundries at prices less than they have been and are selling said virgin sheet aluminum to jobbing foundries." The company also denies that it has contracts with certain consumers at prices below those made to other comparable consumers, on the condition that aluminum scrap resulting from their manufacturing operations be sold to the Aluminum Company of America. The company admits that it pays higher prices for certain qualities of scrap aluminum than it costs to manufacture primary aluminum. It also admits the transfer of primary aluminum to subsidiaries at arbitrary prices as this "is a customary and convenient way of handling such transactions."

In its reply the Aluminum Company points out that it has been engaged in the manufacture of aluminum since 1888, in accordance with methods set forth in its patents, which give it a lawful monopoly in the manufacture of aluminum during their life. Although the last of these patents expired in 1907, the same processes are still in use. It is declared that since the expiration of those patents the company has done nothing to prevent any one from engaging in the manufacture or fabrication of aluminum.

Plans for Reduction in Number of Fertilizer Formulas

Consideration of a definite reduction in the number of fertilizer analyses recently decided upon by the executive committee of the National Fertilizer Association has revealed that the problem is far from simple. In one state no less than 350 formulas are being offered. While that is an extreme example, excess varieties of fertilizers are being produced throughout the country. It is believed that these varieties can be reduced to twelve in some localities and not to exceed twenty in any case. The association now has its data in sufficiently definite shape to take up the matter with the Simplification Division of the Department of Commerce.

Canadian Newsprint Output Still Increasing

The fact that American newsprint mills appear to be feeling more and more the keen competition of Canadian mills, is the subject of considerable comment in Canada at present. In three months of the present year, Canadian production has surpassed that of the United States, and for the month of August the production figures of Canada and the United States are practically identical.

An indication of the more predominating place which Canada is taking in this industry may be judged from the fact that during August the Canadian newsprint mills operated at 90 per cent capacity, whereas United States mills operated only on 84 per cent basis.

Production of newsprint in Canada during August amounted to 120,656 tons and shipments to 120,272 tons. Production in the United States during the same period amounted to 120,902 tons and shipments to 119,752 tons.

Census of Dyes and Synthetic Organic Chemicals

The U. S. Tariff Commission has just issued a Census of Dyes and Other Synthetic Chemicals for 1924. The work is a survey of the domestic dye and synthetic organic chemical industry for the year mentioned. It presents the results of a special investigation into home production of coal-tar dyes and synthetic organic chemicals, both of coal-tar and other origin. It includes a detailed census of dye imports and official statistics for imports and exports of coal-tar dyes by the large consuming and producing nations of the world. A section also is devoted to the tariff rates imposed on dyes by 26 of the principal dye-consuming countries.

Board of Appeals Appointed To Review Alcohol Cases

The Internal Revenue Department has established a Board of Appeals to review all hearings connected with the alcohol trade and other commodities which come under the scope of the Prohibition Unit. The announcement states: "A Board of Appeals, the members to consist of Julian Sharpnack, chairman, V. Simonton, and Patrick J. Finn, any two of whom shall constitute a quorum, is hereby established, which Board of Appeals shall, in the name of the Commissioner of Internal Revenue, and to the extent herein provided, review all hearings subject to review under these regulations, and make such findings of fact and reach such conclusions of law thereon, as the case may warrant and enter a final order affirming, modifying or reversing the original decision or that rendered on re-hearing; and to that end the said Board of Appeals may from time to time make appropriate rules for the conduct of its business, not inconsistent herewith."

Distribution Problems Subject of Washington Meeting

Upward of two hundred economists, editors, advertising and business men engaged in the study or application of the manifold methods by which commodities find their way from the producer to the ultimate consumer will meet in Washington in December to chart what has hitherto been virtually an unmapped region in the broad field of commerce—domestic distribution.

This field of economic exploration embraces everything that comes under the name of marketing. It extends from the retail store to the great manufacturing plant with selling agencies in all corners of the country, covering not merely the actual passing of goods and commodities from hand to hand but also the methods by which buyer and seller are brought together and an equilibrium maintained between supply and demand.

News from Washington

By Paul Wooton

WASHINGTON CORRESPONDENT OF *Chem. & Met.*

THOSE in Washington who follow industrial progress closely are convinced that artificial silk is destined for a commercial development akin to that of radio apparatus, the automobile or rubber manufacture. This great raw material, developed in the chemical laboratory, will be used much more extensively, it is predicted, once production can catch up with the demand. When that point is reached price concessions will be made. Means of reducing costs will be devised and this new synthetic textile will become available for use in new and wider fields.

Not only is the rapidly expanding rayon industry displacing large quantities of silk, but it is reaching the point where it is successfully invading the field of cotton textiles. It even has become a competitor of the paper industry for wood pulp.

The development of rayon is welcomed particularly by New England where its manufacture is offsetting the loss of cotton mills to the South. In this instance New England is particularly well located as to raw material supplies. It has spruce of its own and is close to sources of pulp in Canada and is the nearest part of the United States to the pulp supplies originating in the Scandinavian countries.

Just as soon as the chemist solves the problem of increasing the tensile strength of rayon, and there is reason to believe that this will not be long, a broad new market will open and it will be possible to use the synthetic silk for sheer fabrics.

The development of the rayon industry has been aided to no small extent by good fortune, it is admitted. The disorders and floods in China and the earthquakes in Japan have forced many textile manufacturers to use it. Since textiles are sold months in advance, nothing could have been so effective in displacing silk as the violent fluctuations in recent years in the price of that commodity.

NITROGEN FIXATION IN GERMANY

Realizing that in the future it must share the world dye market with the United States and other countries, the German Dye Cartel has turned to the fixation of nitrogen, the development of insecticides and medicinals and the production of such articles as methanol, synthol and rayon.

One of the late developments in the broadening-out policy of the cartel is the purchase by the Badische of what amounts to control of the Stinnes-Riebeck lignite and brown coal holdings in Central Germany. Lignite is used at the Badische plants at Merseburg where nitrogen now is being fixed at the rate of 300,000 tons annually and where synthetic methanol is being manufactured.

The acquisition also furnishes raw material and going equipment for the production of paraffine, mineral oil, montan wax and candles.

The Badische is interested also in the development of petroleum substitutes. The brown coal properties just acquired indicates faith in the outcome of experiments in its distillation.

With each passing month, in the opinion of disinterested specialists here, there is less and less excuse for the government to go into the business of fixing nitrogen. An increase in the movement of nitrate of soda from Chile to Germany indicates that even there, where the production comes from plants cleared of debt by the fall of the mark, synthetic nitrogen is going to have difficulty in competing with the Chilean product for fertilizer purposes.

Production of nitrogen in this country, it is pointed out, is profitable because of the demand for uses which can pay higher prices than the fertilizer manufacturers. There is a limit, however, to the amount of synthetic ammonia which can be taken as anhydrous ammonia. It is regarded as very certain that most of the production at Muscle Shoals would have to find a market as fertilizer. To be able to compete with natural nitrate from Chile would require a heavy import duty on the Chilean product or a heavy subsidy to maintain the production, either of which would be calculated to arouse an adverse public opinion. It is believed that there is little opportunity to use secondary power for fertilizer manufacture. Moreover, there are many who feel that it would not be fair to the pioneers in nitrogen fixation for the government to put them out of business.

In this connection the point also is made that Congress, in fairness to private enterprise, should arrive speedily at a permanent Muscle Shoals policy. As it is, many concerns considering this type of activity are waiting until they can be sure they will not have to compete with the United States Government. The most conspicuous example is the development of the large water power at Priest Rapids on the Columbia River. American rights have been secured for the use of foreign processes for fertilizer production. Construction of the project has been delayed, however, by the uncertainty as to whether the government would go into the fertilizer business at Muscle Shoals.

TARIFF CHANGES IMPROBABLE

Communications being received by members of Congress indicate a very determined opposition to any opening up of the tariff at this session of Congress. This is not confined to those who benefit directly by the existing rates. Many who are affected adversely by the present duties prefer to see the law go unchanged rather than subject business to the long period of uncertainty sure to accompany any effort to revise the tariff act.

The dye industry is convinced that it could justify the restoration of the duties which were reduced automatically last year, but all indications are that the majority believes it is better to forego 15 per cent of certain dyes than to subject the whole chemical schedule to the pulling and hauling which is certain to accompany any effort to revise the law.

With taxation, merchant marine, and reclamation to begin on, there will be no dearth of business calculated to absorb the time and energies of the legislators. The tariff probably will come in for no real attack.

Japan's Chemical Industry Association will conduct its second Chemical Fair next spring. Preliminary announcements indicate that this event will outshine the association's first fair, held in 1917.

The exhibits, which will cover forty-one distinct chemical activities, will depict the progress which has been made in each line during the past decade. The major exhibits will include the following: heavy chemicals; electrochemical products; metal ware; ceramic articles; rubber and leather goods; compressed gas; fuel materials; dyestuffs; fertilizers; explosives; safety matches; implements for chemical warfare; mineral oils; grease and fats; imitation leather; linoleum; soap; candles; essences; toilet goods; artificial silk; printing presses and printers' supplies; instruments and scientific apparatus for educational and medicinal uses; precision tools and measuring instruments; lighting, heating and burning equipment; refrigerators; safety devices, preparations and devices for resisting heat, fire and water; antiseptics; packing materials; books; periodicals and statistical compilations on physics and chemistry.

INCREASED METHANOL DUTY UNOPPOSED

Apparently no material objection is to be raised against the proposed increase in the methanol duty under the flexible provisions of the tariff. The general impression is that the President will allow the 50 per cent increase which the law allows. There are many who think this course will do no good, as they believe German costs are so much below ours that the foreign product could pay the increased duty and still have a handsome margin left. They can see no harm in such action by the Tariff Commission, as the only persons who will lose are the importers who will have to surrender a portion of their profit. Germany will suffer no hardship.

Reports reaching Washington from Germany are to the effect that the Badische's production of methanol this year will reach 15,000 tons. Its 1926 production promises to be 25,000 tons, it is said. Present production is coming from the Mercersburg plant but other units are to be opened at Oppau and at Ludwigshausfen. The great bulk of the German production is going into dyes, resins, and other products which because of the cheaper methanol have an advantage in foreign markets over the American product.

News in Brief

Chemical Warfare Association Meets—A general meeting of the United States Chemical Warfare Association was held at the Chemists Club, New York City, on Oct. 1. Dr. J. E. Mills, Director of Research at Edgewood Arsenal, delivered an extremely interesting and instructive address on gas warfare. The president gave a brief outline of the affairs of the Association and pointed out the present indebtedness and the difficulties in financing the Association. The resignation of Secretary Frank B. Gorin was presented and accepted with appreciation of his work. Upon motion it was voted to refer to the executive board with power to act, the question of the future of the association.

Bureau of Mines Makes Study of Whiting — A study of the production and utilization of whiting has been undertaken by the Bureau of Mines. W. M. Weigel, mineral technologist, has begun the collection and tabulation of available published information and has established contact with domestic producers of whiting.

Potash Producers in Long-Term Agreement—A common interest agreement has been signed by the Wintershall companies and the Kali-Industrie interests in Germany. The agreement, which will expire December 31, 1953, provides for the closing of high cost mines and concentrating production in the low cost properties. Such properties are to be modernized thoroughly. The companies that are parties to the agreement are entitled to furnish 40 per cent of the total potash sales.

New Limestone Company in Canada—Limestone almost pure calcite has been discovered in Bathurst Township, six miles from Perth, Ontario. A group of Montreal capitalists have formed a company and have already started operations to install a mill.

Chemical Salesmen Elect Officers—As a result of a recent mail ballot the Salesmen's Association of the American Chemical Industry of New York will have the following as officers for the ensuing year: president, Elias A. Johnson; 1st vice-president, Benjamin Hotchkiss; 2nd vice-president, 3rd vice-president, R. S. Bosworth; secretary, W. H. Adkins; treasurer, Robert Quinn.

Du Pont Rayon Co. to Expand—The Du Pont Rayon Co. plans erection of $8,000,000 addition to its Buffalo plant which will be double the size of the present rayon factory. It will be completed in eight or ten months and will employ between 3,000 and 4,000 people in addition to the 2,000 now employed. Present plant has an output of 4,000,000 lb. of rayon annually and the new plant will have a capacity of about 8,000,000 lb.

Will Expand Capacity of Sulphite Mill—To meet a growing demand the International Paper Co. will expand the capacity of its bleached sulphite mill at Kipawa, Northern Ontario, Canada, to about 250 tons daily, at a cost of between $1,500,000 and $2,000,000. Present facilities permit daily production of about 170 tons.

Texas Carbon Gas Hearings Postponed—The State Railroad Commission of Texas has postponed for an indefinite period a series of proposed hearings, originally slated to begin on Sept. 28, for permission to use casinghead gas at Breckinridge for the manufacture of carbon black, as proposed by a number of interests. Plants are to be established for the production if the commission sanctions the activities.

Rubber Exchange for New York—At a recent meeting of representatives of the rubber industry, it was voted to establish a rubber exchange in New York City. A committee comprising F. R. Henderson, C. T. Wilson, and W. E. Bruyn was appointed for the purpose of investigating the operation of exchanges and to submit recommendations at a future meeting.

New Members for American Institute of Chemists—The American Institute of Chemists recently elected to membership, Paul H. Brattain, consulting chemist, Washington, D. C.; Aubrey V. Fuller, vice-president and treasurer of the Vail Laboratories, Washington, D. C.; Ivor Griffith, chief chemist, John B. Stetson Co. Laboratory, Philadelphia, Pa.; George W. Pressell, chief chemist, E. F. Houghton & Co., Philadelphia, Pa.; Joseph F. Padula, assistant chemist, Navy Yard, Brooklyn, N. Y.; and D. W. Villinger, chief lamp engineer, Nilco Lamp Works, St. Marys, Pa.

Canada Develops Peat Deposits on Commercial Scale

The development of peat on a commercial basis is now well under way in Canada. Peat Fuels, a company formed to develop the peat bog at Alfred, Ontario, has between two and three thousand tons of peat ready for marketing in Central Canada.

The new company is the first of its kind in Canada to endeavor to develop peat bogs on a commercial scale. The idea was first given serious consideration in 1918 when the federal and Ontario governments appointed a joint committee to investigate whether or not peat fuel could be produced commercially. This committee existed for five years, by which time the investigation had been carried far enough to point the way to capitalists for the successful manufacture of a domestic and industrial fuel from Canada's peat resources.

The important thing about this development, as far as Canada's fuel problem is concerned, is the fact that it is situated in what is usually referred to as the acute fuel area which lies between Montreal on the East, and Winnipeg on the West. In this area practically all fuel has to be imported from the United States, as the haul from Eastern and Western Canadian mines is too long.

Merger of German Chemical Companies Reported

Reports from Germany have reached this country in the past week, to the effect that plans for a gigantic merger of German dye and chemical companies had been agreed upon. According to these reports the new company will be called the Interessengemeinschaft der Farbenindustrie Aktiengesellschaft and will include the Badische Anilin und Sodafabrik, Friedrich Bayer Co., Elbersfelder Dyes, Weiler ter Meer, Aktiengesellschaft fur Anilin Fabrik, and several others. The new organization is reported to be in a position practically to control the manufacture and sale of aniline dyes, pharmaceutical and photographic chemicals, nitrogen products, and rayon in Germany.

New England Paint Club Holds Annual Meeting

The Paint, Oil and Varnish Club of New England held its annual meeting Sept. 24 at the Parker House, Boston, Mass. Arthur P. Felton, a former president, spoke interestingly of the early days of the club. At the business meeting the following officers were elected: president, William H. Kirkpatrick, Boston; vice-president, George N. Hathorne, Worcester; secretary and treasurer, Fred L. Moses, Boston; and William E. Gilmour, Nathaniel A. Billings, Fred F. Ingraham, John C. W. McKim, L. Waldo Thompson, Frank A. Spooner and Fred B. Keene were named directors. Two new members were Luke Hall, Boston manager for Devoe & Reynolds Co., Inc., and Frank H. Appleton of the Wadsworth Howland & Co.

Sale of Whalen Pulp and Paper Mills Postponed

To enable second mortgage bondholders of the Whalen Pulp and Paper Mills, whose two plants on the British Columbia coast are now being operated under direction of a receiver, to negotiate further for a purchaser of the concern's assets, the Supreme Court granted a postponement of the date of the sale from Sept. 30 to Oct. 30. Eastern Canadian and New York interests are said to be bidding for the property, which, according to the receiver, earned profits of approximately $90,000 during the month of July and August last.

Experimental Work in Grinding and Molding Talc

The Bureau of Mines at its Columbus experiment station has obtained very encouraging results in experiments with talc. Talc when calcined becomes as hard as quartz and has excellent dielectric qualities. The commercial practice in the making of electric heaters has been to carve the necessary models out of soft talc. Before the burning can be completed there is large loss. The Bureau of Mines has demonstrated that the material can be ground up and molded into any form so as to possess a considerable amount of permanence.

Electro-Chemical Industry in France Developed Since the War

Increase in Hydro-Electric Power Aided in Growth of Manufacturing Companies—Industrial Alcohol Under Control

From Our Paris Correspondent

THERE has been a considerable development of hydro-electric Power in France. Up to 1913, 750,000 hp. had been installed in this country. During the war, from 1916 to 1918, 450,000 hp. was set up; from 1919 to 1921, 400,000 hp. has been added, so that one can reckon the total power actually installed on rivers and streams of France, to be approximately 2,500,000 hp., almost one million of which is taken up by the electro-chemical and metallurgical industries.

It is evident that the greater part of the water-power under control serves for the production of power and light; however, more than one-third is utilized for the electro-metallurgical and electro-chemical industries which have taken on a considerable importance in the Isère and Pyrenean regions.

The calcium carbide industry which produced 40,000 tons before the war, now turns out 110,000 tons in 21 plants out of which about 40,000 tons are transformed in calcium cyanamide and about 10,000 tons go to the chemical industries for producing aldehydes, acetic acid, trichlorethylene, and so on, which products have already been discussed in a previous letter.

The aluminum industry produces about 25,000 tons annually. Among other industries is the production of metallic sodium which is used in organic synthesis for the making of artificial indigo, of sodium peroxide for bleaching, of chlorates which reaches 16,000 tons annually and that of phosphorus in which the output is about 400 tons.

Since the war France has also produced cerium and ferro-cerium which came particularly from Austria. However these industries are of minor importance and use little current compared to the making of ferro-silicon, ferro-titanium, ferro-vanadium, electric furnace iron and steel. For certain ferro-alloys the French industry is an exporter.

Lastly electric current is used in fixing nitrogen in the form of nitrate and cyanamides. This question of nitrogen fixation in France will be the subject of one of our future contributions.

Beet-Sugar Industry

Of 214 sugar plants, 148 were destroyed as the consequence of the war and accordingly the treating capacity of 100,000 tons of beets per 24 hours was reduced by 68,000 tons. With the indemnities granted for the reconstruction of the devasted regions, plants have been rebuilt which can turn out 55,000 tons. But instead of 110 plants, only 50 of a proportional increased capacity, have been set up. In fact, before the war, most of the French plants could only treat an average of 460 tons of sugar-beets per 24 hours; the capacity of the actual installations varies between 600 and 1,000 tons. Some plants even treat from 1,200 to 1,800 tons; the largest is the Eppeville sugar-plant with a yield of 3,500 tons. Since this reconstruction the production of the sugar industry in France has nearly reached its pre-war record figure of 1,200,000 tons in 1900.

Control of Industrial Alcohol

The question of industrial alcohol in France is rather singular. Since the passage of the law of June 30, 1916, and owing to the large demand of alcohol for the making of smokeless powder during the war, the State has taken over the control of alcohol and buys the whole production at prices determined by decree. Prices vary according to the origin but not according to the market-price of sugar, so that this industry has been compelled to give up certain processes notable among which uses corn as a basis. Besides, in order to reduce the consumption of alcohol which before the war was very high, it has been forbidden to use industrial alcohol for beverage purposes and only that produced by the fermentation of wines, ciders, beets and fruits may be used for this purpose. This latter production has developed considerably at the expense of the former.

The pre-war alcohol production was 3 million hectol.; it had fallen to 821,000 hectol. in 1919 but went up to 1,733,000 in 1922. But whereas the beverage alcohol production in 1913 was only of 250,000 hectol., that is to say 8 per cent of the production, this proportion actually reaches nearly 50 per cent. We might add that in addition to the 3 million hectol. of alcohol by distillation, the output of 60 million hectol. of wine corresponds to approximately 5 million hectol. of 100 per cent alcohol.

From the 3 million hectol. produced before the war, more than half, exactly 55 per cent, was used for beverage purposes and 25 per cent, 750,000 hectol., was used for industrial and domestic purposes.

Alcohol for Motor Fuel

In spite of the decreased production, the industrial and household uses have not been able to absorb the whole quantity of the alcohol produced. The State found itself embarrassed with the alcohol stocks which it had accumulated by buying the whole production. To get rid of it, it has, by the act of February, 1923, compelled the importers of gasoline (essence) to add absolute alcohol corresponding to 10 per cent of their importation the previous month. This law was made to develop the use of alcohol "carburant national" (power alcohol), the formula of which has had much success but has not yet been completely realized. For this use they had to create special processes for the dehydrating of the alcohol but the result has not been easily achieved. Meanwhile, to foster the use of the "carburant national," the State sells carburated alcohol at a loss; it finds a compensation in the de luxe alcohols, (for perfumery, etc.) which command very high prices.

This alcohol policy of the French State has created bitter feeling with the producers and particularly with the sugar-beet growers; this bitterness has been augmented by the fact that the French State imports vast quantities of alcohol from Germany under the reparation agreements. It is true that the French State, in its defence, answers the growers that the low price of the alcohol received from Germany allows it to pay a higher price for the French alcohol. Nevertheless the French production of industrial alcohol is steadily growing.

The solution of the alcohol motor fuel problem must, in our opinion, be sought from raw materials other than agricultural products, e.g., cellulose or coal. In this connection it is of interest to know that the Cie. de Béthune which has a successful process for making ethyl alcohol utilizing the metheylene from coal gas as a starting point. This company is actually building a plant which will turn out 8,000 kilogr. of ethyl alcohol per day.

Canadian Chemists Hold Ninth Annual Meeting

A representative body of Canadian scientists gathered in Ottawa, Canada, in latter part of September and listened to a series of addresses upon technical subjects relative to various manufactories and industries, the occasion being the ninth annual meeting of the associate committee of chemists of the National Research Council of Canada.

A paper on research in connection with Canadian magnesite was read by F. E. Lathe, technical assistant to the president of the National Research Council. The manufacture of ethyl alcohol was dealt with by Col. F. M. Gaudet, director of the Canadian Industrial Alcohol Co. of Montreal. Organization of research in the paper and pulp industry was the subject of a paper by E. P. Cameron and suggestions for research work in Canadian industries were outlined by Dr. G. S. Whitby. The chair was occupied by Dr. R. F. Ruttan, director of the department of chemistry, McGill University.

Research Division Organized by Oil Marketers

The National Petroleum Marketers' Association, Chicago, has organized a new economic research division, with objects to study conditions and economics in the industry, gather and analyze data regarding production, distribution and consumption of oil and oil products. The initial work will cover a detailed investigation of the supply of oil and oil products, with special reference to the more or less temporary sources of supply. S. H. Nerlove has been appointed head of the research division.

Favorable Report on Waste Straw for Paper Making

The government of the province of Alberta, Canada, has issued a special report dealing with experiments in the making of paper products from waste straw, in which it is stated that an effort is being made to interest capital in a proposal to establish a plant or plants in the province. The government expresses confidence in the success of such an enterprise, and states that the results of the experiments made have been of the greatest importance not only to the farmers but to the general industrial development of the province.

Investigations were made into all known experimental processes for the manufacture of pulp from straw, and finally about two years ago the government made arrangements for laboratory tests of the Bache-Wiig process in the pulp and paper division of the Forest Products Laboratories, Montreal, under the joint supervision of E. Parke Cameron, the superintendent of the division, and John Bache-Wiig, who was co-inventor with his father in the process. As a result of the success which attended the tests, the Alberta government employed a well known pulp and paper engineer to make a local survey of the conditions which were necessary for the commercial success of a plant in the province. The following points were considered: Availability of straw with an economic radius; availability and cost of coal; availability and cost of salt and sodium sulphate; railway facilities and freight rates; labor conditions; water and sewage facilities.

An exhaustive report on these subjects has been received by the government, covering a number of points in the province. This report together with all technical reports is being placed at the disposal of groups of capital who may be interested in the development of this industry.

Decline in Value for Mexican Oil Properties

Due to the declining production in the Tampico oilfields, Mexico, and the necessary establishment of new pipe line outlets, the past few months has shown heavy abandonment of previously used pipe line terminals and sea-loading lines along the Gulf Coast of Mexico, from Tecomate to Agua Dulce, about 18 mi. Property which originally cost approximately $34,000,000 in this district is estimated to have a salvage value of but $4,000,000. Compania Petrolera del Agwi, an interest of the Atlantic, Gulf & West Indies Steamship Co., has abandoned its terminal at Tecomate, which represents an investment of about $9,000,000, and has also discontinued operations at its topping plant at this same place. The Island Oil & Transport Co., has abandoned its sea-loading line and terminals at Palo Blanco, and has closed down, as well, a 2,000-bbl. capacity topping plant here, the entire works having cost more than $5,000,000. Other interests have also discontinued, the latest being the International Petroleum Co., at Chorreras, which has abandoned terminals and pipe lines constructed in 1922 at a cost of close to $6,000,000.

Size of Lumps a Factor in Using Casein for Paper Making

In the preparation of casein for use as an adhesive in coating paper, the importance of the size of the particles must not be overlooked, the Bureau of Standards warns.

A casein manufacturer recently submitted a sample of such material to the Bureau's laboratory for test. The sample had been rejected by a coated paper manufacturer who stated that it was unsuitable for his use on account of its insolubility. The material was in the form of coarse lumps, some as large as ¼ x ½ inch. While the casein could not be dissolved in this form with the usual coating mill solvents, upon grinding to suitable size it readily dissolved, and was found to be a very high grade material in all respects.

Germans Will Manufacture Dyes in Czechoslovakia

According to recent reports a number of German aniline manufacturers have combined in the formation of a Czechoslovak company, to be known as Tofa. The following German manufacturers are included: The Badische Aniline Factory, Afga, Griesheim and Casella. A factory will be opened at Reichenberg in the near future with a branch in Brunn.

It is the announced purpose of the new company to produce dyes which will compete directly with those being sold by Swiss and French firms which have managed to secure a foothold in the Czechoslovak market. No details as to the amount of production are obtainable, but according to the published announcement every effort will be made "through the use of German technical skill, and the introduction of quantity production to undersell foreign competitors in this market."

Larger Sulphuric Acid Output in Fertilizer Trade

The Department of Commerce announces that, according to data collected at its recent semiannual canvass, fertilizer manufacturers during the first half (Jan.-June) of 1925 produced 855,338 tons of sulphuric acid and consumed 971,984 tons in the manufacture of 1,800,226 tons of acid phosphates containing 30,142,960 units, of 20 lb., of available phosphoric acid. The production of sulphuric acid by fertilizer manufacturers was thus equal to 88 per cent of their total consumption. Acid phosphate sold as such amounted to 1,352,868 tons, containing 22,263,105 units of available phosphoric acid; and 1,203,272 tons, containing 19,414,885 units, were consumed in the manufacture of other fertilizers.

The statistics for the first half of 1925 as compared with the first half of 1924 show an increase of 13.6 per cent in production of acid phosphates, together with decreases of six-tenths of 1 per cent in total sales of acid phosphates, 4.7 per cent in stocks of sulphuric acid on hand at the end of the period, and seven-tenths of 1 per cent in stocks of acid phosphates.

The table, herewith, shows the production, consumption, sales, and stocks of sulphuric acid for the three-month periods from Jan. 1, 1924, to June 30, 1925. The differences between the figures for stocks on hand at the end of one period and the beginning of the next are due in part to the inclusion of data for new establishments and the dropping out of establishments previously included, and in part to the fact that in some cases the reports are apparently estimates. Data for 1924 and the first half of 1925 follow.

Sulphuric Acid Production

United States	1925 Jan.-June Tons	1924 July-Dec. Tons	1924 Jan.-June Tons
Stocks on hand at beginning of period	108,586	104,404	126,946
Produced in establishment reporting	855,338	779,370	797,174
Purchased	330,219	333,906	234,247
Total	1,294,143	1,217,680	1,158,367
Consumed in making fertilizers	971,984	895,915	886,901
Sales:			
To fertilizer works	128,700	143,619	115,458
To other than fertilizer works	93,473	68,901	51,121
Stocks on hand at end of period	99,986	109,245	104,887
Southern District			
Stocks on hand at beginning of period	55,868	51,801	71,579
Produced in establishment reporting	461,567	428,101	377,269
Purchased	180,474	210,844	123,076
Total	697,909	690,746	571,924
Consumed in making fertilizers	536,625	510,792	427,000
Sales:			
To fertilizer works	68,453	91,607	68,875
To other than fertilizer works	39,353	32,186	23,583
Stocks on hand at end of period	53,478	56,161	52,466
Northern and Western Districts			
Stocks on hand at beginning of period	52,718	52,603	55,367
Produced in establishment reporting	393,771	351,269	419,905
Purchased	149,745	123,062	111,171
Total	596,234	526,934	586,443
Consumed in making fertilizers	435,359	385,123	459,901
Sales:			
To fertilizer works	60,247	52,012	46,583
To other than fertilizer works	54,120	36,715	27,538
Stocks on hand at end of period	46,508	53,084	52,421

Men You Should Know About

GEORGE K. HAMILL has succeeded Dr. V. H. Gottschalk as research associate for the National Association of Glue Manufacturers. He is carrying on this work in the paper section, Bureau of Standards, Washington, D. C.

DR. JAMES E. MILLS, Director of Research at Edgewood Arsenal, addressed the general meeting of the United States Chemical Warfare Association, Chemists' Club, New York, Oct. 1.

PROF. JOHN B. ABBOTT, formerly of the Agronomy Department of the Massachusetts Agricultural College at Amherst, has joined the National Fertilizer Association as field agronomist for the Northern states, with field headquarters at Bellows Falls, Vermont.

DR. ELLWOOD HENDRICK has returned to his duties as Curator of the Chandler Muesum at Columbia University after a vacation of several months spent largely in England and Scotland. A recent book by Dr. Hendrick, "Lewis Miller, A Biographical Essay," has just been published by G. P. Putnam's Sons.

DR. JOSEPH M. BRAHAM, who for some time has been chief of the chemical division of the Fixed Nitrogen Research Laboratory, has resigned to

Joseph M. Braham

accept a position in the research and development department of the Atmospheric Nitrogen Corporation, Syracuse, N. Y.

W. T. READ has been appointed head of the department of chemistry in Texas Technological College, a new institution. Professor Read, who was formerly connected with the Yale University, will take up his new work immediately.

DR. ALEXANDER FINDLEY of Aberdeen, Scotland, recently spoke before the Rochester (N. Y.) section of the American Chemical Society, the Washington Academy of Sciences and the Chemical Society of Washington (D. C.) and at Cambridge, Mass., on "Appeal of Science to the Community."

GEORGE MULLEN, chief chemist and secretary of the Lowville Cheese Mfg. Co., Lowville, N. Y., has resigned, effective immediately, and will become chief chemist for the Anchor Cap and Closure Corp., Long Island City, N. Y.

CHARLES E. KOCH, chief chemist of the West York, Pa., plant of the Sandusky Portland Cement Co., has resigned and will become president of the York Vault Co., York, Pa., which is a newly organized company.

H. E. TURLEY, chief chemist in the research department of the American Institute of Baking, has resigned and will become identified with the Stein Hall Mfg. Co., Chicago, Ill., as chief chemist in the research department.

WILLIS Z. GEORGIA, of Olean, N. Y., was re-elected president of the National Wood Chemical Association at the annual meeting of the organization held at the Hotel Statler, Buffalo, N. Y. W. H. Mathews of Memphis, Tenn., was re-elected vice-president and F. J. Goodfellow of Bradford, Pa., secretary and treasurer.

HOWARD COONLEY, formerly president of the Boston Chamber of Commerce, Boston, Mass., has been appointed chief of the first Chemical Warfare Service procurement district, under the direction of Major General Amos A. Fries, chief of the service at Washington, D. C. Mr. Coonley was president of the United States Shipping Board during the World War and is well fitted for the honor bestowed upon him. He will have jurisdiction over the manufacture of gas masks and other chemical warfare equipment for the Boston district, which includes the whole of New England. In accepting the position Mr. Coonley said that he considered chemical warfare one of the most constructive measures for preparedness that has been put into effect in this country.

M. L. MURRAY, who has been engaged in the wire business for the past 36 years, has resigned his position as secretary, treasurer and general manager of the Alloy Metal Wire Co., Moore, Pa.

EMERSON P. POSTE, formerly director of the laboratory of the Elyria Enameled Products Co., is now superintendent of enamels at the Chattanooga Stamping & Enameling Co., Chattanooga, Tenn.

JOHN KEARNS, general manager of the Lee Tire & Rubber Co., Conshohocken, Pa., has left for a six-months' trip around the world to study conditions in different rubber centers.

SETH HAYES has been appointed instructor in chemistry at Cleveland College, Cleveland, O.

F. A. KEMP, sugar technologist, was the principal speaker at the opening meeting of the season of the Beet Sugar Technical Society, Denver, Colo., Sept. 21.

T. HOLLAND NELSON, consulting metallurgical engineer, vice-president of the William T. Bate & Son Co., Conshohocken, Pa., gave an address before the members of the Lehigh Valley Chapter of the American Society for Steel Treating at Bethlehem, Pa., Sept. 11, on the subject "Rust, Scale and Corrosion Resistant Materials."

C. C. CONCANNON, of the chemical division of the Department of Commerce, has been appointed a member of the Far Eastern division of the department on the inter-departmental committee of experts advisory to the federal narcotics control board.

H. L. KAUFFMAN, chemical engineering graduate of Pennsylvania State College, and since April, 1924, chief chemist of the 10,000 bbl. refinery of the Producers and Refiners Corporation at Parco, Wyo., has been appointed

H. L. Kauffman

superintendent of the lubricating oil manufacturing department of that refinery. Construction of this unit was recently completed by the J. G. White Engineering Corp.

W. H. CROWLEY has been appointed resident engineer at the new plant now being constructed by the Great Western Sugar Co., at Ovid, Colo. George Devinish and R. J. Nelson have been appointed assistant engineers at the mill.

DR. PAUL H. FALL has returned to the department of chemistry at Hiram College, Hiram, O., after a two years' leave of absence, during which time he has been engaged in research at Cornell University. He will occupy the chair of chemistry at Hiram.

PROF. D. U. HILL, of Arcadia University, has been elected secretary and treasurer of the Canadian Institute of Chemistry for the ensuing year.

E. J. CORNISH, president of the National Lead Co., New York, has recently returned to the city from a trip to Europe. While abroad he arranged for the acquisition of the Williamsburg smelter in Germany, for a subsidiary organization.

DR. RALPH KAUFMAN has become assistant professor of organic chemistry at the University of Louisville, Ky. During the past year he has occupied the chair of chemistry at Hiram College, Hiram, O.

DR. FREDERICK W. PATTERSON of Princeton University, has returned from a trip to Europe, where he attended the

meetings of the international committee on chemical nomenclature, and sessions of the Chemical Congress held at Bucharest, Roumania.

DR. V. H. GOTTSCHALK, formerly research associate for the National Association of Glue Manufacturers, is now connected with the U. S. Bureau of Efficiency, working on the investigation of currency paper.

DR. DAVID WESSON, on whose name the receivers of the Southern Cotton Oil Co. have decided to capitalize in re-organizing that corporation as the Wesson & Snowdrift Co., is to continue as technical director of the new company with laboratories and office in New York City.

LEHIGH UNIVERSITY, at the annual Founders' Day exercises on Oct. 7, conferred an honorary degree on Professor Samuel Wilson Parr of the University of Illinois.

HAROLD FARKAS of Newark, N. J., and Maurice S. Brunstein of Atlantic City, undergraduates, were awarded the degree of chemical engineer.

Obituary

Professor Edward De Mille Campbell

From the life and work of Prof. Edward De Mille Campbell of the University of Michigan, who died at Ann Arbor, September 19, after a brief illness following an operation, scientists and technologists can draw a lesson of courage and fortitude almost unexampled in professional circles. In 1892 Prof. Campbell lost his sight in an explosion during a laboratory investigation of steel, and although he was then only 28 years of age and held the position of assistant professor of metallurgy, he continued his work with such perseverance and signal success that at the time of his death he was professor of chemistry and metallurgy and director of the chemical laboratory, a position which he had held since 1920. In spite of his handicap Prof. Campbell achieved a position of distinction and honor in chemical and metallurgical circles. His studies and investigations on the chemical constitution and physical properties of steel gained world-wide acceptance and he was honored in scientific circles abroad as well as at home. He contributed 75 research papers to scientific literature, all but three of them being published after he lost his sight. At the time of his death two contributions were completed but unpublished.

After his accident Prof. Campbell adapted himself to a state of blindness as to a new environment and deliberately ordered his life and activities for constructive work. It was his purpose to contribute to the progress of the world as much as though he had retained his sight. During his 35 years of service in the University of Michigan one of his achievements was the building of a new chemical laboratory, in the construction and equipment of which he supervised the minutest detail. In order to keep abreast of current literature he established a unique seminar in chemistry known as "Course 34" for which he selected five of the advanced students who read aloud to him from scientific journals. Each student spent 2 hours a week in this service, Prof. Campbell discussing the subject with him and giving him the benefit of his knowledge.

Those who had the privilege of a personal acquaintance with Prof. Campbell always found him in good spirits, genial and affable. His serenity was rarely if ever disturbed. He was one who will be missed in the circles in which he was known.

Edward DeMille Campbell was born in Detroit, Sept. 9, 1863. He graduated from the University of Michigan in 1886, and was married to Jennie M. Ives of Cincinnati, in 1888. He had six children, four of whom he had never seen. After his graduation he held several industrial positions and was appointed assistant professor of metallurgy at the University of Michigan in 1890, remaining in that Institution until the time of his death. During the war he was consulting chemist to the Ordnance Department. He was a member of numerous scientific societies and honorary fraternities. He is survived by his wife, three sons and three daughters.

ALFRED COTTON BEDFORD, chairman and former president of the Standard Oil Co. of New Jersey, died unexpectedly of angina pectoris Sept. 21, at his home in East Norwich, L. I. His illness dated from his return from Europe last July. During the World War Mr. Bedford was active as chairman of the petroleum committee of the Council of National Defense and was credited with devising the "gasless Sundays" and other means of economizing the use of gasoline.

FREDERICK F. SMITH, chemical engineer and dye-maker for the Wickwire Brothers Co., Cortland, N. Y., for the past sixteen years, died Sept. 26, following a lingering illness, at the age of 48 years.

Calendar

AMER. ENGINEERING COUNCIL, Administrative Board meeting, Columbus, O., under the auspices of the Engineers Club of Columbus, Oct. 29 and 30.

AMERICAN INSTITUTE OF CHEMICAL ENGRS., Cincinnati, O., Dec. 2 to 5.

AMERICAN REFRACTORIES INSTITUTE, Fall meeting, Waldorf-Astoria Hotel, N. Y., Oct. 29.

AMERICAN SOCIETY FOR TESTING MATERIALS' COMMITTEES will hold a 3-day session, Cleveland, O., Oct. 27 to 29.

AMERICAN WELDING SOCIETY. Fall meeting, Boston, Oct. 21, 22 and 23.

NATIONAL ASSOCIATION OF PRACTICAL REFRIGERATING ENGINEERS, 16th Annual Convention and educational exhibition, Detroit, Mich., Dec. 8, 9, 10, 11 and 12.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING (Fourth), Grand Central Palace, N. Y., Nov. 30 to Dec. 5.

NATIONAL FERTILIZER ASSN., (Southern Division) Hotel Biltmore, Atlanta, Ga., Nov. 10 and 11.

NATIONAL INDUSTRIAL ADVERTISING ASSOCIATION. Hotel Chalfonte, Atlantic City, Oct. 19, 20 and 21.

Industrial Notes

FOOTE BROS. GEAR AND MACHINE CO., Chicago, announces that its president, W. C. Davis, has recently been appointed a member of the Committee on Commercial Gear Standards of the American Gear Association. This company also announces that W. McNamee, formerly purchasing agent for the Holt Mfg. Co. of Peoria, Ill., has recently joined the sales organization of the company. Mr. McNamee has been appointed district representative for the State of Indiana and all of Illinois except that section lying west and south of Springfield which is handled from the St. Louis office. Territory within a radius of 35 miles of Chicago in both Indiana and Illinois is handled from the home office.

THE BRIDGEPORT BRASS CO., Bridgeport, Conn., announces that Harold Bates has recently joined the sales department and will be engaged with matters pertaining particularly to sales organization and research.

THE MINER EDGAR CO. announces that Dr. Henry V. Walker of Newark, N. J., is now president and general manager. Henry M. Miner will assume the duties of treasurer and chairman of the board of directors. Harold T. Edgar will assume the duties of vice-president.

THE AMERICAN SCHAEFFER & BUDENBERG CORP., Brooklyn, N. Y., has decided to re-establish its New England sales office in "downtown" Boston and offices have been engaged in the new Chamber of Commerce Bldg., 80 Federal St. Coincident with this change, the company is transferring its Boston plant to Worcester, where all stock will be maintained.

DIAMOND POWER SPECIALTY CORP. of Detroit announces that the territory of the Lathrop-Trotter Co., 733 Union Trust Bldg., Cincinnati, Ohio, which has been sales representative for the Diamond Power Specialty Corp. in the Cincinnati territory for many years, has been extended to take in Indianapolis and the adjacent territory in Central and Southern Indiana.

THE LINDE AIR PRODUCTS CO., New York, announces that L. M. Zimmer has been appointed general sales manager of that company and of the welding gas division of The Prest-O-Lite Co., Inc., succeeding L. M. Moyer, who resigned Aug. 1.

THE ELECTRIC CONTROLLER & MFG. CO. has appointed Eicher & Bratt, Seattle, as representatives for the sale of EC&M control equipment in the states of Oregon, Washington, Alaska, and the "Pan Handle" district of Idaho. In addition to this Eicher & Bratt represent the Pittsburgh Transformer Co., Jewell Electric Instrument Co. and the Electric Power Equipment Corp.

Market Conditions and Price Trends

Heavy Contract Buying of Chemicals In Prospect

Consuming Trades Await Announcement of Prices for Deliveries of Heavy Chemicals Over Next Year

CONSUMERS of chemicals are now showing interest in the forthcoming prices for contract deliveries which will be effective over next year. In some cases contracts are now being written but some of the more important heavy chemicals have not yet been priced for distant positions. During the last quarter of last year there was an active trading movement in the market for chemicals and by the end of the year, some manufacturers had a large part of their 1925 output sold ahead. Similar conditions are expected to prevail in the closing months of this year and it would not be surprising if contract placements would reach record proportions.

Taking as an authority the latest figures for employment as collated by the Department of Labor and which cover the month of August, the relative position of industries, which are large consumers of chemicals, may be visualized for that month in comparison with the corresponding period for last year. The accompanying table contains the index numbers of employment in some of these industries. In every case it is found that the number was higher for August of the present year than for August, 1924. In other words, manufacturing activities have been on a higher scale than in the preceding year. To a greater or less extent the proportion of increase would hold good for consumption of chemicals in these industries. Comparisons for preceding months of this year have shown up in a corresponding manner and there is ample evidence that consumption of chemical products for the first eight months of the year was of larger volume than for the eight-month period of 1924. Index numbers for employment during August offer the following comparisons:

Index of Employment	Aug., 1925	July, 1925	Aug., 1924
Dyeing and finishing textiles	95.2	96.0	84.6
Leather	88.0	86.5	82.0
Paper and pulp ..	93.6	94.2	91.2
Chemicals	90.0	90.4	85.1
Fertilizers	81.8	67.6	62.7
Glass	90.1	91.1	81.4
Automobile tires ..	121.5	119.0	98.2
Petroleum refining.	97.4	96.3	92.6

While these figures for employment are the latest available which may be taken as official, private reports have been of a tenor to encourage the belief that industrial expansion has been noteworthy during the past month. Carloadings continue to reach large totals. Building permits in September were unusually large and a steady market for pigments, colors, oils, solvents, and chemicals which enter into the paint and varnish trades, seems assured. Incidentally official reports on the production of paints and varnishes for the first half of the year have just been announced and show that these industries are continuing on the same active plane that has characterized them in the past two years.

The textile industry is rapidly working into a better position. A report from one of the largest cotton manufacturing centers of New England states that operations are proceeding almost at capacity. One of the largest woolen companies is expanding activities and by the end of this month is expected to be working at 85 per cent of capacity. The rayon industry is forging ahead in an unprecented manner and plans for enlarged outputs are being rushed by some companies. The slowing up in the automobile tire industry is but a natural reaction following the very active season which preceded.

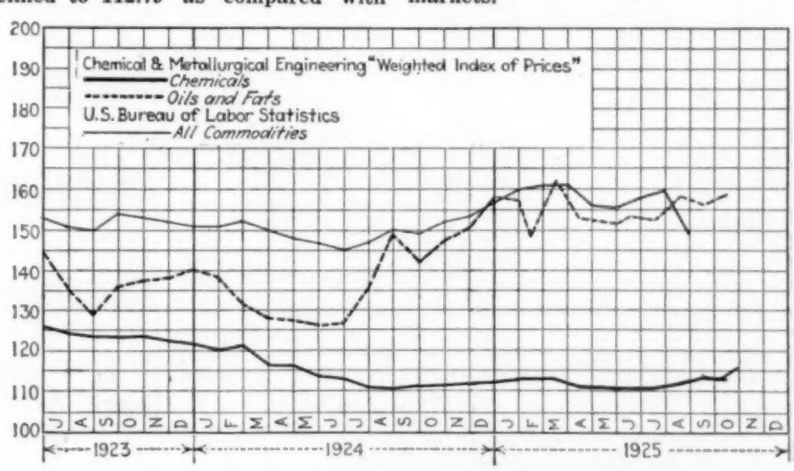
Market values for important chemicals have shown very little fluctuation during the month. Higher prices for the metal brought about an upward revision for the tin salts and some of the lead salts also were higher in price. Limited offerings of some coal-tar chemicals, such as solvent naphtha and zylol have stiffened the market and while the former quotations are maintained by producers they mean but little as premiums are asked by second hands for whatever prompt material is available. Lower prices were effective for anhydrous ammonia, butanol, and benzol and the weighted index number declined to 112.79 as compared with 112.84 a month ago, and 111.10 a year ago.

Vegetable oils and fats have been marked by a strong undertone to prices. An exception is found in the case of cottonseed oil. New crop production of seed, while variously estimated, is undoubtedly large and ginning has been very large to date. Hence crude oil has been under selling pressure and values have declined. Most of the other oils have held at high price levels and have had a strengthening effect on the weighted index number. The latter now rests at 158.21 which compares with 156.04 last month and 147.30 for the corresponding period last year.

Increase in Export Trade

Exports of chemicals and allied products in August, which is the latest month for which official figures are available, were larger than in any of the preceding months of the year and, in value, represented an increase of 26 per cent over August, 1924. The percentage of gain if made on a quantity basis would be even larger as some of the groups reported a gain in volume and a loss in value which is accounted for by a lowering in the unit price from that which prevailed in August last year. It is noted, however, that the average values for exports of naval stores was much higher than a year ago which condition is easily explained by the position of domestic markets.

Exports of industrial chemicals were reported at a valuation of $2,180,600 with material increases in tonnage over the outward shipments of last year. Foreign buyers accounted for the movement of 94,000 tons of fertilizers and fertilizer materials. The latter was valued at $1,374,600 or approximately a gain of 30 per cent. All the items listed under the heading of paint and varnish registered gains over the totals for August, 1924, and an increasing outlet for these materials seems to have been developed in foreign markets.



Market Conditions and Price Trends

Paint and Varnish Production For First Half of Year

Large Increase in Output of Pyroxylin Varnishes and Lacquers Features Semi-annual Canvass of Manufacturers

STATISTICS showing production of paint and varnish, have just been issued by the Department of Commerce. The figures were collected in the semi-annual canvass of paint and varnish manufacturers and refer to the first six months of the present year. Interesting comparisons also are afforded by the inclusion of statistics for the corresponding period of last year.

According to the data collected, there was produced during the six-month period from Jan. 1 to June 30, 1925, 241,057,300 lb. of paste paints. In this total is included 154,978,500 lb. of white lead in oil, 7,297,200 lb. of zinc oxide in oil, and 78,781,600 lb. of other paste paints. The output of ready-mixed and semi-paste paints is reported at 52,448,700 gal. Varnishes, japans, and lacquers were produced to the extent of 36,514,400 gal. and this total does not include the output of pyroxylin varnishes and lacquers which was separately reported at 4,880,200 gal.

One of the most interesting features found in these figures consists in the rapid increase which is pointed out in the case of pyroxylin varnishes and lacquers. Manufacture of these products was so small prior to 1924 that production figures were not given separately for that group. In the six-month period from Jan. 1 to June 30, 1924, the output of producing plants reached a total of 1,430,700 gal. In the second half of 1924, production was increased to 2,160,300 gal. which in turn was more than doubled in the first half of the current year. The most recent canvass shows that there are 67 plants in this country making pyroxylin varnishes and lacquers. As there were but 45 plants reported in the latter half of 1924, it is evident that the increase in production is partly due to the entrance of new factors on the producing end. The geographic division reveals that 29 of these plants are located in the East North Central states and 24 in the Middle Atlantic states. Three plants are operating in New England and three on the Pacific Coast with the four each in the West North Central and East South Central states.

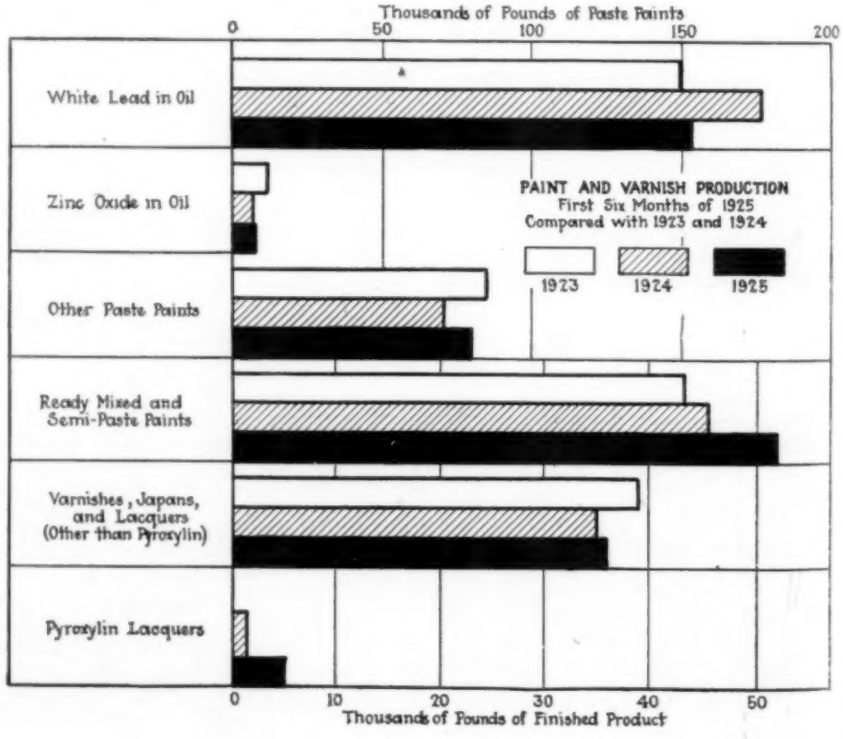
The statistics for the first half of 1925 as compared with the last half of 1924 show increases of 3.1 per cent for paste paints, 21.5 per cent for ready-mixed and semipaste paints, 13.6 per cent for varnishes, japans, and lacquers, other than pyroxylin, and 125.9 per cent for pyroxylin varnishes or lacquers. Comparison of the first half of 1925 with the first half of 1924 brings out a decrease of 5 per cent for paste paints, with increases of 16.2 per cent, 5.2 per cent, and 241.1 per cent, respectively, for ready-mixed and semipaste paints; varnishes, japans and lacquers other than pyroxylin; and pyroxylin varnishes or lacquers. The accompanying table gives detailed production according to the different classifications. Reports also are included to cover sales during the six-month period and figures for the corresponding period of 1924 are given to show the changes which have taken place in these industries.

The statistics are based upon returns from 502 establishments, of which 108 reported the manufacture of pure white lead in oil; 101, combination or graded white lead in oil; 150, zinc oxide in oil; 301, other paste paints; 409, ready mixed and semipaste paints; 299, varnishes, japans, and lacquers, other than pyroxylin; and 67, pyroxylin varnishes or lacquers.

Data are included for 27 establishments that reported for the last half of 1924 but not for the first half of 1925. For these establishments the production for the first half of 1925 has been estimated on the basis of the ratio which their production for the last half of 1924 bore to the production of the establishments which reported for both periods. These 27 establishments reported for the last half of 1924, only three-tenths of 1 per cent of the paste paints, 2.5 per cent of the ready-mixed paints, and 3 per cent of the varnishes, japans, and lacquers.

PRODUCTION OF PAINT AND VARNISH—FIRST HALF 1925 AND 1924

	Total Production	Total Sales	Establishments Reporting Sales: Industrial	To Marine Dealers and Shipyards	To Other Jobbers and Dealers	Not Classified
Paste paints						
Jan.–June, 1925, lb.	241,057,300	190,543,900	25,840,600	2,972,200	153,140,800	8,590,300
Jan.–June, 1924, lb.	253,744,100	203,045,500	21,262,600	2,774,400	175,886,000	3,122,500
White lead in oil						
Jan.–June, 1925, lb.	154,978,500	144,141,300	9,559,500	1,052,300	128,168,500	5,361,000
Jan.–June, 1924, lb.	177,259,000	163,172,600	7,192,400	979,100	154,455,600	545,500
Zinc oxide in oil						
Jan.–June, 1925, lb.	7,297,200	5,767,800	485,600	124,700	4,910,200	247,300
Jan.–June, 1924, lb.	5,960,000	4,625,600	501,200	80,900	3,944,800	98,700
Other paste paints						
Jan.–June, 1925, lb.	78,781,600	40,634,800	15,795,500	1,795,200	20,062,100	2,982,000
Jan.–June, 1924, lb.	70,525,100	35,247,300	13,569,000	1,714,400	17,485,600	2,478,300
Ready-mixed and semi-paste paints, including wall paints and enamels						
Jan.–June, 1925, gal.	52,448,700	39,479,800	11,769,100	1,469,200	22,848,300	3,393,200
Jan.–June, 1924, gal.	45,122,500	29,467,400	9,745,900	2,489,600	13,429,100	3,802,800
Varnishes, Japan, and lacquers, other than pyroxylin						
Jan.–June, 1925, gal.	36,514,400	22,598,900	13,005,000	312,900	7,491,700	1,789,300
Jan.–June, 1924, gal.	34,718,300	21,525,900	12,073,300	474,700	7,134,100	1,843,800
Pyroxylin varnishes and lacquers						
Jan.–June, 1925, gal.	4,880,200	4,394,300	3,744,600	16,500	383,000	250,200
Jan.–June, 1924, gal.	1,430,700	1,004,000	871,200	12,700	18,200	101,900



Market Conditions and Price Trends

Facts and Figures of Business

in Chemical Engineering Industries

PRODUCTION in manufacturing industries during August was less than in July at 122 per cent of the 1919 average as measured by the index number of the Department of Commerce. An increase of 12 per cent, however, is indicated in comparison with August, 1924.

Industrial Statistics Presented Graphically for Those Who Follow the Monthly Trends of Production and Consumption

The principal increases over July occurred in the production of iron and steel, with a gain of 10 per cent, and lumber with a gain of 7 per cent, while slight increases occurred in leather and stone, clay and glass products. Decreases occurred in the production of foodstuffs, textiles, non-ferrous metals, tobacco and miscellaneous items while paper and printing output and the production of chemicals and oils remained the same. Compared with a year ago all groups except manufactured foodstuffs showed increased output.

The output of raw materials was 6 per cent less than in August, 1924, the marketings of animal products decreasing 1 per cent and crop marketings 19 per cent while mineral and forestry products showed increases of 17 per cent and 4 per cent, respectively.

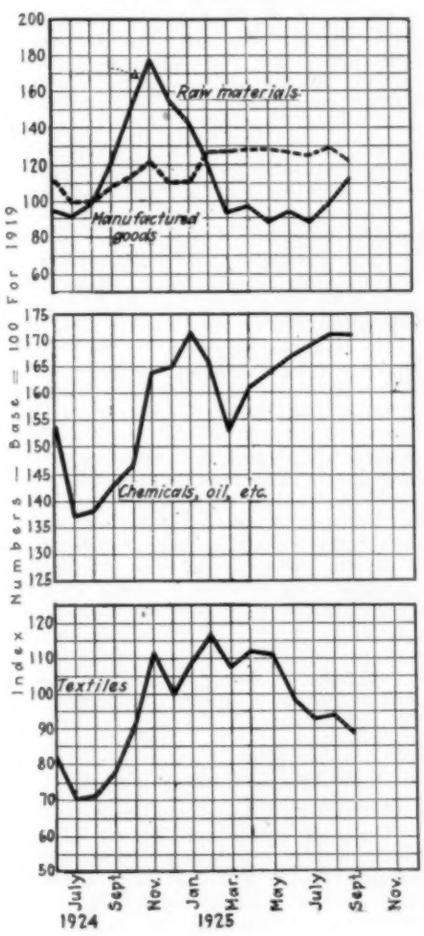
The index of unfilled orders showed a slight increase over July and was 13 per cent higher than a year ago, both the iron and steel and building-materials groups being higher than August, 1924.

Stocks of commodities held at the end of August showed an increase of 5 per cent over July when allowance is made for seasonal variation, and increased 2 per cent over a year ago. Stocks in the raw foodstuffs group increased over July, but were slightly less than a year ago, those for raw materials for manufacture and manufactured commodities increasing over both periods, while the manufactured foodstuffs group declined from the preceding month and for the corresponding period of last year.

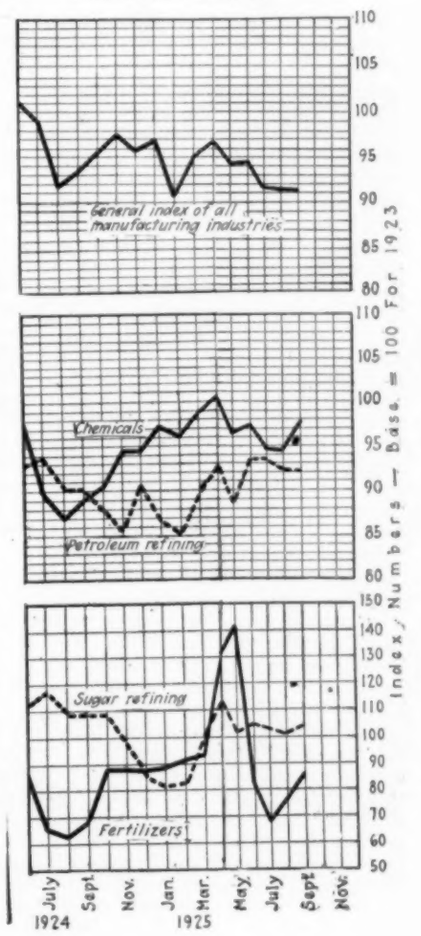
Information collected by the Bureau of Labor Statistics shows that the general level of wholesale prices in August was slightly higher than in July. The Bureau's weighted index number, which includes 404 commodities or price series, registered 160.4 for August compared with 159.9 for the preceding month.

Farm products advanced above the July level. Small increases were likewise recorded in the groups of cloths and clothing, metals and metal products, building materials, and chemicals and drugs.

Volume of Production

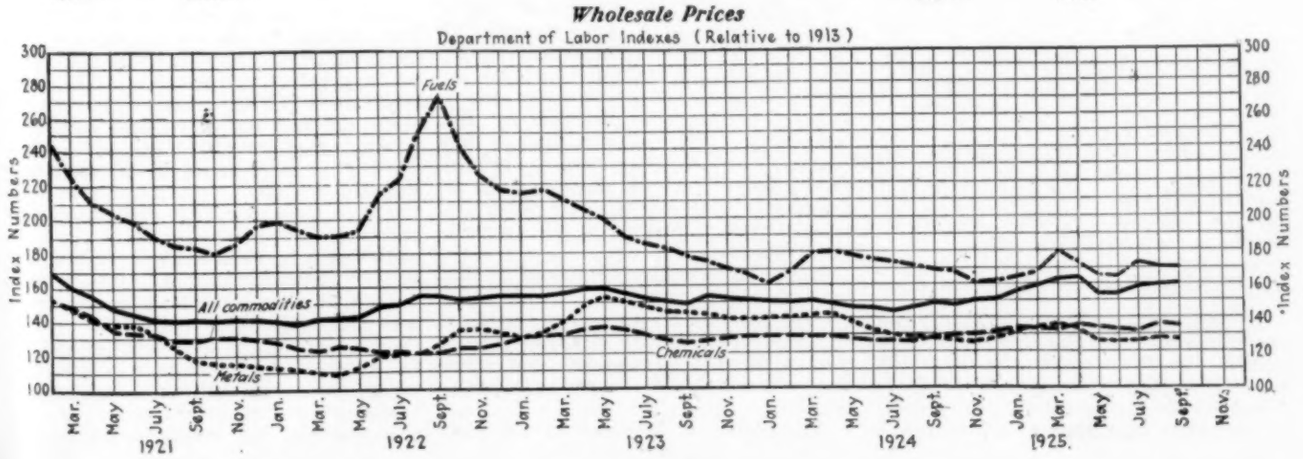


Index of Employment



Wholesale Prices

Department of Labor Indexes (Relative to 1913)


Fuels
All commodities
Chemicals
Metals
Index Numbers
Mar. May July Sept. Nov. Jan. Mar. May July Sept. Nov. Jan. Mar. May July Sept. Nov. Jan. Mar. May July Sept. Nov. Jan. Mar. May July Sept. Nov.
1921 1922 1923 1924 1925

Market Conditions and Price Trends

Sharp Reduction Made in Prices For Ammonia Products

Lower Producing Costs and Competitive Selling Bring About Radical Change in the Market—Considerable Business Placed for Next Year Delivery

DEVELOPMENTS in domestic production of synthetic ammonia have reached a stage where they have become of prime importance as factors in determining market values. In the first place, the cost of producing some of the ammonia products is said to have been greatly decreased, and this, combined with increased productive capacities of plants has presented a logical reason for a reduction in sales prices. The situation, however, has been further complicated by a keenness in competition on the part of sellers, under which pressure values have fallen below the expectations of buyers. The spot situation has been easy for some time, due to rather large surplus holdings which, in certain quarters, was regarded as a temporary condition, due to an unusual discrepancy between supply and demand. That such was not the case became manifest when the information became public that certain producers were approaching large consumers and soliciting 1926 contracts at prices which were very attractive, in comparison with those which had prevailed for deliveries in the current year. To safeguard their interests, other producers sent announcements to the consuming industries in which they expressed their willingness to name low prices on 1926 business. Quotations of 15c. to 17c. per lb. have been given as a new contract price for anhydrous ammonia. Aqua ammonia has been available at 5½c. per lb.

Up to the present time the market for ammonia products has been largely dominated by producers who were using coal-tar by-products as a raw material. With synthetic products coming on the market in a larger way there arises the question of competition for the consuming trade. The latter question, in turn, reverts to producing costs at the individual plants and to what extent producers, who are at a disadvantage in that regard, will be willing to sacrifice profits in order to meet competition. The one point which appears to be clearly defined is that consumers are to be favored with a low-priced era for these products, with the possibility that the lowest levels have not yet been reached, and that the lowering of prices may be extended to include practically all the ammonia derivatives.

Active Call For Solvents

In the census figures which were recently issued for domestic paint and varnish production for the first six months of this year, ample proof is found for the statement that the output of pyroxylin varnishes and lacquers is increasing at a rapid rate. Their use in the automobile trade has been well established, and the furniture and other trades are offering new outlets, which promise to add materially to the total consumption. This condition has created a more active demand for some of the solvents, and in some cases the increase in demand has not been met by a corresponding enlargement in production.

> ***Leading Market Developments During the Month***
>
> **Firmness in primary markets has resulted in an increase in prices for importations of potash salts.**
>
> **Crushers of linseed have put into effect their recently devised plan of quoting linseed oil on a pound basis.**
>
> **The market for coal-tars is featured by a sold up condition for solvent naphtha and xylol.**
>
> **Keen competition is reported in the market for ammonia products and prices have declined sharply.**
>
> **Treasury decision places imports of calcium ferrocyanide and other ferrocyanides on dutiable list.**

In the past few weeks there has been a marked scarcity of xylene. Different consumers who were accustomed to buy in the open market whenever they were in need of supplies, have found difficulty in securing stocks. Producers have been using their entire production to satisfy contract commitments, and there has been no opportunity to accumulate stocks with which to meet other demands. Owing to the difficulty in segregating xylene and the relatively small amount which is found in light oils, there is but little inducement for producers to develop this material as a main product and a rapid increase in the output is not to be expected. Hence the present situation surrounding supply is more than temporary and a scarcity of stocks is probable for the remaining months of the year, if not longer. The effect on prices is obvious, as any reduction from present levels is practically impossible, and advances would be warranted purely on a supply and demand basis.

A similar situation is found in the case of solvent naphtha, with the spot market bare of stocks and uncertainty existing regarding the time when supplies will again be available in volume large enough to fill consuming requirements.

This condition, however, is not general throughout the list of materials which may be listed as solvents. Offerings of benzene have increased in volume and with competing materials lower in price, sellers of benzene announced a reduction in price in the first week of this month. Butyl alcohol also is in plentiful supply and was lowered in price largely because of the easier position of important raw materials which enter into its manufacture.

A notable change has taken place in recent months in the foreign trade in copper sulphate. During the greater part of last year imports of this chemical were in excess of exports. The presence of foreign-made sulphate in domestic markets had a depressing effect on values with imported material usually offered at the lowest prices. Round lot shipments of the latter also were made by all-water routes to Pacific Coast points, thus proving that European material was able to overcome the handicap of freight differentials in competition with the domestic product at points far distant from the Atlantic seaboard. Throughout the present year imported sulphate has occupied a minor position in our markets. In addition to domination of the home markets, domestic sulphate has found a wider outlet in foreign markets. Exports have shown a gain in volume which testify to the successful efforts of American sellers to compete with foreign makers. It is particularly noted that the greater part of South American trade has been filled by domestic sulphate and there have been rumors that European factors had adopted a policy which was practically equivalent to a proration of foreign markets, by which South American countries were left to American shippers. Whether or not such rumors are founded on fact, developments have been in favor of home producers and the outlook for the industry is promising.

Interest in Contract Prices

The last quarter of the year usually is featured by a trading movement which centers in placing contracts for delivery over all, or the greater part of the ensuing year. In some cases, the contracting movement already has gained considerable headway and in others, consuming trades are awaiting the announcement of new contract prices by producers. The general state of industry is favorable for a large contract business in the next few months, and if realized this will round out a year of progress in the chemical and allied fields.

Leading factors have just informed the trade that prices for bicarbonate of soda would be on a basis of $2 per 100 lb. for carloads, in bbl., f.o.b. works. This is continuation of the price which was quoted for 1925 deliveries. From this it may be deduced that conditions as referred to production costs are about on a par with those which obtained at this time last year. In fact this material has maintained a steady

Market Conditions and Price Trends

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	**112.79**
Last month	112.84
October, 1924	111.10
October, 1923	123.71

There was very little change in price in the series of chemicals on which the weighted index is based. As a rule heavy chemicals were steady and changes in the miscellaneous list were not important. Lower prices for benzol and ammonia aided in the downward movement of the weighted index number.

position throughout the year, and there was very little reason to look for a revision in price for the coming year.

New prices for soda ash and caustic soda have not yet been issued. The favorable outlook for consumption, the large tonnage moved this year, and practically unchanged production costs are regarded as pointing to an unchanged level for soda ash. To a greater or less extent this holds true for caustic soda. The price for the latter has been less stable than that for ash and while the open quotation has not been changed during the year, there have been times when competition caused a disregard for quotations and sales were made at private terms below the quoted market figure. Export business also was put through at varying price levels, but the latter were less significant, because export business was subject to outside competition and there was an incentive to prevent stock accumulations and to hold up plant operations on a steady basis. While it is possible that new contracts for caustic may be written at a slight concession from the 1925 figure, there has not been change enough in any phase of the industry to make this more than probable.

Liquid chlorine has improved its position materially during the year with distribution on the largest scale in the history of the product. Different producers have increased their outputs and while offerings have been ample at all times, competition has not been of a nature to disturb values. This is a factor which will be important in establishing new contract prices. In other words, prices will depend largely on costs of production, with an absence of price-cutting considerations. On this basis a continuance of a steady market price is logical.

Bleaching powder has suffered in quantity production almost in inverse ratio to the increase in the output of liquid chlorine. In many consuming quarters, it was held that prices for this year were rather high, and the price differential worked in favor of chlorine. As producers seem to favor the latter, there will probably be no attempt to revive the use of bleach and a smaller production should mean a higher unit production cost and thus warrant a continuance of present market quotations for the coming year.

Bichromates have been selling in good volume for next year delivery and with improvement in the leather and textile trades a large consumption is expected in the coming year. There has been very little change in the position of raw materials which are used in making bichromates. This has influenced some producers to continue the prevailing quotation of 6½c. per lb. for the soda product. There is a limited number of large consumers, however, whose business takes up a large part of domestic production and they are favored with prices under those quoted to the smaller buyers. Generally, these large buyers find contract prices depend on the degree of competition shown by sellers. Last year some contracts were reported to have been placed as low as 6c. per lb., but it is doubtful if they will be able to cover at that figure in the present market, although the quotation of 6½c. per lb. is by no means being adhered to.

Many consumers of linseed oil have placed orders for Jan.-April deliveries, but a large part of the trade has held off with the expectation that lower prices would follow as the movement of seed to market took on larger volume. Earlier in the year, belief was fairly general that oil would sell during the Fall at close to 80c. per gal. These hopes have been dissipated by reports of unfavorable conditions in flax-growing states and estimates have convinced that the seed outturn would be considerably below the totals for the preceding season. The Canadian crop promises but little assistance and the first official estimate from the Argentine places the acreage at 5,700,000 which is a decrease of 9.7 per cent from last year. With the seed supply below that of last year it would follow that a higher average price level would prevail for oil in the coming year. When the yield of seed is fairly large, the lowest prices for oil generally, are found in November, with an advance in price following the close of inland navigation. Last year the period of low prices was of short duration, because active buying became a more important market factor than seed supply. Demand for oil should play an important part in oil prices between now and the end of the year. In any case large declines are not indicated by existing conditions.

Duty on Ferrocyanides

Uncertainty regarding the tariff classification of ferrocyanides recently has caused delays in entering goods of foreign origin, and the matter was referred to the Treasury Department for a ruling. The latter has advised that these products are to be subject to an ad valorem duty of 25 per cent, but modified this to the extent that this would not apply for thirty days, and in the meantime, importations would be granted entry as had been the custom prior to this ruling. The effect of this order may be noticeable in a lessening in competition from foreign markets, which ultimately may work out in a higher price for home products. Importations of ferrocyanides have not been heavy, but in some cases they have had considerable influence in establishing market values which will be lost when the import levy becomes effective.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	**158.21**
Last month	156.04
October, 1924	147.30
October, 1923	137.71

The fact that crude cottonseed oil sold at lower levels during the month was more than offset by the strong position of coconut, chinawood, palm, menhaden, and oleo oils and the weighted index number shows a gain for the period.

Hankow Exports of Wood Oil

August exports of wood oil from Hankow, China, totaled 13,100,000 lb., of which 12,900,000 lb. were shipped to the United States, according to cable advices to the Department of Commerce. Prices during the month were high, on August 3, at $14.96, and low on August 19, at $14.60 per picul. A picul equals 133⅓ lb.

Exports of Chemicals

	Aug., 1925	Aug., 1924
Benzol, lb	7,191,834	5,823,443
Aniline oil and salts, lb.	63,870	349
Acid, acetic, lb.	19,187	49,282
Acid, boric, lb.	74,845	29,663
Acid, sulphuric, lb.	440,954	851,858
Methanol, gal.	9,881	77,547
Aluminum sulphate, lb.	2,871,312	2,342,858
Acetate of lime, lb.	1,230,614	727,709
Calcium carbide, lb.	317,397	597,684
Bleaching powder, lb.	2,089,525	1,420,088
Copper sulphate, lb.	104,476	105,979
Formaldehyde, lb.	106,638	232,148
Potassium bichromate, lb.	67,302	127,227
Sodium bichromate, lb.	520,651	.....
Sodium cyanide, lb.	73,231	22,733
Borax, lb.	2,671,593	3,524,186
Soda ash, lb.	1,820,143	2,841,138
Sodium silicate, lb.	3,663,521	3,487,013
Sal soda, lb.	1,006,988	1,064,906
Caustic soda, lb.	8,922,999	6,872,574
Sulphate of ammonia, ton	10,200	7,289

Imports of Chemicals

	Aug., 1925	Aug., 1924
Dead or creosote oil, gal.	3,922,418	10,417,622
Naphthalene, lb.	375,964	263,988
Pyridine, lb.	89,215	53,691
Arsenic, lb.	821,834	570,970
Acid, citric, lb.	112,448	448
Acid, formic, lb.	132,923	78,518
Acid, oxalic, lb.	275,942	247,516
Acid, sulphuric, lb.	2,015,800	838,600
Acid, tartaric, lb.	238,760	88,632
Ammonia chloride, lb.	300,525	387,897
Ammonia, nitrate, lb.	1,631,911	490,310
Barium compounds, lb.	2,124,084	1,393,189
Calcium carbide, lb.	400,220	2,061,565
Copper sulphate, lb.	112,650	99,257
Bleaching powder, lb.	131,513	94,200
Potassium cyanide, lb.	131,185	138,937
Potassium carbonate, lb.	670,983	295,082
Potassium hydroxide, lb.	674,413	570,791
Potassium chlorate, lb.	650,686	507,389
Sodium cyanide, lb.	2,198,240	1,581,281
Sodium ferrocyanide, lb.	49,373	276,227
Sodium nitrite, lb.	11,196	46,222
Sodium nitrate, ton.	92,082	61,798
Sulphate of ammonia, ton	197	164

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to October 13.

Industrial Chemicals

		Current Price	Last Month	Last Year
Acetone, drums	lb.	$0.12 –$0.13	$0.12 –$0.13	$0.12 –$0.16½
Acid, acetic, 28%, bbl.	cwt.	3.00 – 3.25	3.00 – 3.25	3.12 – 3.37
Boric, bbl	lb.	08½– .10	08½– .10	.09 – .09½
Citric, kegs	lb.	45½– .47	45½– .47	.45½– .47
Formic, bbl	lb.	10½– .11	10½– .11	.11½– .11¾
Gallic, tech., bbl	lb.	.45 – .50	.45 – .50	.45½– .47
Hydrofluoric 30% carb.	lb.	06½– .07	06½– .07	.06½– .07
Lactic, 44%, tech., light, bbl.	lb.	13½– .14	13½– .14	.12½– .13
22%, tech., light, bbl	lb.	06½– .07	06½– .07	.06 – .06½
Muriatic, 18°, tanks	cwt.	.80 – .85	.80 – .85	.80 – .85
Nitric, 36°, carboys	cwt.	04¼– .04½	04¼– .04¼	.04 – .04¼
Oleum, tanks, wks.	ton	17.50 –20.00	17.50 –20.00	16.00– 17.00
Oxalic, crystals, bbl.	lb.	10½– .11	10½– .11	.09½– .10
Phosphoric, tech., c'bys	lb.	.07 – .07½	.07 – .07½	.07 – .08
Sulphuric, 60°, tanks	ton	8.50 – 9.50	8.50 – 9.50	8.00 – 9.00
Tannic, tech., bbl	lb.	.35 – .40	.35 – .40	.45 – .50
Tartaric, powd., bbl	lb.	.27½– .30	.27½– .30	.26½– .29
Tungstic, bbl	lb.	1.00 – 1.20	1.00 – 1.20	1.20 – 1.25
Alcohol, ethyl, 190 p'f. U.S.P. bbl	gal.	4.90½– 5.00½	4.85 – 4.90	4.84 –.....
Alcohol, Butyl, dr	lb.	.24½– .25½	.24½– .25½	.27 – .30
Denatured, 190 proof No. 1 special dr	gal.	54½–.....	.48½–.....	.56 –.....
No. 5, 188 proof, dr.	gal.	53½–.....	.47½–.....	.50 –.....
Alum, ammonia, lump, bbl	lb.	03½– .04	03½– .04	.03½– .04
Chrome, bbl	lb.	05½– .05½	05½– .05½	.05½– .06
Potash, lump, bbl	lb.	02½– .03½	02½– .03½	.02½– .03½
Aluminum sulphate, com., bags	cwt.	1.40 – 1.45	1.40 – 1.45	1.35 – 1.40
Iron free, bg	cwt.	2.00 – 2.10	2.00 – 2.10	2.35 – 2.45
Aqua ammonia, 26°, drums	lb.	05½– .06	.06 – .06½	.06½– .06¾
Ammonia, anhydrous, cyl.	lb.	.15 – .17	.30 – .32	.28 – .30
Ammonium carbonate, powd. tech., casks	lb.	.11 – .11½	.12 – .12½	.12½– .12¾
Nitrate, tech., casks	lb.	.08 – .08½	.08 – .08½	.09 – .10
Sulphate, wks.	cwt.	2.80 – 2.85	2.75 – 2.80	3.75 – 2.80
Amylacetate tech., drums	gal.	2.75 – 3.25	2.75 – 3.25	2.50 – 2.60
Antimony Oxide, bbl.	lb.	.17½– .18	.18 – .18½	.12 – .12½
Arsenic, white, powd., bbl.	lb.	03½– .04½	03½– .04¼	.06½– .07
Red, powd., kegs	lb.	.12 – .12½	.12½– .13	.14½– .15½
Barium carbonate, bbl.	ton	52.00 –54.00	48.00 –52.00	55.00 –57.00
Chloride, bbl.	ton	61.00 –63.00	58.00 –60.00	73.00 –74.00
Nitrate, cask	lb.	.07 – .07½	.07½ – .07½	.07½– .08
Blanc fixe, dry, bbl	lb.	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks., drums	cwt.	1.90 – 2.00	1.90 – 2.00	1.90 –.....
Borax, bbl.	lb.	.05 – .05¼	.05 – .05¼	.05½– .05¾
Bromine, cs.	lb.	.47 – .49	.47 – .49	.34 – .38
Calcium acetate, bags	cwt.	2.75 – 2.80	2.75 – 2.80	3.00 – 3.05
Arsenate, dr	lb.	.07 – .08	.06 – .07	.08 – .09
Carbide drums	lb.	.05 – .05¼	05½– .06	.05 – .05¼
Chloride, fused, dr., wks.	ton	21.00 –.....	21.00 –.....	21.00 –.....
Phosphate, bbl.	lb.	.07½– .07¾	.07½– .07¾	.07½– .07¾
Carbon bisuphide, drums	lb.	05½– .06	05½– .06	.06 – .06½
Tetrachloride drums	lb.	.07 – .07½	.07 – .07½	.06½– .07
Chlorine, liquid, tanks, wks.	lb.	04 – .04½	.04 – .04½	.04½–.....
Cylinders	lb.	.05½– .08	.05½– .08	.05½– .08
Cobalt oxide, cans	lb.	2.10 – 2.20	2.10 – 2.20	2.10 – 2.25
Copperas, bbl., f.o.b. wks.	ton	13.50 –14.00	13.00– 14.00	15.00 –16.00
Copper carbonate, bbl	lb.	16½– .17	16¾– .17	.17 – .17½
Cyanide, tech., bbl	lb.	.49 – .50	.49 – .50	.49 – .50
Sulphate, bbl.	cwt.	4.50 – 4.60	4.50 – 4.60	4.40 –.....
Cream of tartar, bbl.	lb.	.21½– .22	.21½– .22	.21 – .21½
Epsom salt, dom., tech., bbl.	cwt.	1.65 – 2.00	1.75 – 2.00	1.75 – 2.00
Imp., tech., bags	cwt.	1.30 – 1.40	1.30 – 1.40	1.35 – 1.40
Ethyl acetate, 85% drums	gal.	.87 – .90	.87 – .90	.92 – .95
99%, dr.	gal.	1.05 –.....	1.05 –.....	1.08 – 1.10
Formaldehyde, 40%, bbl	lb.	08½– .09	08¼– .09	.09 – .09¼
Furfural, dr.	lb.	.23 – .25	.23 – .25	.25 –.....
Fusel oil, crude, drums	gal.	2.40 – 2.50	2.40 – 2.50	2.00 – 2.25
Refined, dr	gal.	3.25 – 3.50	3.25 – 3.50	3.50 – 4.00
Glaubers salt, bags	cwt.	1.15 – 1.25	1.15 – 1.25	1.20 – 1.40
Glycerine, c.p., drums, extra	lb.	.19 – .19½	.19 – .19½	.19 – .19½
Lead: White, basic carbonate, dry, casks	lb.	.10½–.....	.10½–.....	.10 –.....
White, basic sulphate, sck.	lb.	.10 –.....	09½–.....	09½–.....
Red, dry, sck	lb.	.12½– .13	.12 – .12½	.11 – .11
Lead acetate, white crys., bbl.	lb.	.14½– .15	.14½– .15	.14½– .15
Lead arsenate, powd., bbl	lb.	.16 – .17	.16 – .17	.16 – .18
Lime, chem., bulk	ton	8.50 –	8.50 –	8.50 –
Litharge, pwd., csk	lb.	11½– .12	11½– .12	10½–.....
Lithopone, bags	lb.	.05½– .06	.06 – .06½	.06½– .06¾
Magnesium carb., tech., bags.	lb.	06½– .07	06¾– .07	08½– .08½
Methanol, 95% dr	gal.	.58 – .62	.58 – .62	.74 – .76
97%, dr.	gal.	.60 – .64	.60 – .64	.76 – .78
Nickel salt, double, bbl.	lb.	.10 – .10½	.10 – .10½	.09 – .10
Single, bbl.	lb.	.10½– .11	.10½– .11	.10 – .11
Orange mineral, csk.	lb.	.14½–.....	.14 –.....	.14 –.....
Phosphorus, red, cases	lb.	.70 – .75	.75 – .80	.70 – .75
Yellow, cases	lb.	.34 – .36	.34 – .36	.37½– .40
Potassium bichromate, casks.	lb.	.08½– .08¾	.08¼– .08½	.08½– .08¾
Carbonate, 80-85%, calc., csk.	lb.	.06 – .06½	05½– .06	.05 – .05½
Chlorate, powd.	lb.	.08½– .09	.08½– .09	.07 – .07½
Cyanide, cs.	lb.	.55 – .58	.55 – .58	.47 – .62
First sorts, csk.	lb.	$0.08½–$0.09	$0.08½–$0.09	$0.08½–$0.08½
Hydroxide (caustic potash) dr.	lb.	.07½– .07½	.07½– .07½	.06½– .07
Muriate, 80% bgs	ton	34.55 –.....	34.55 –.....	34.55 –.....
Nitrate, bbl.	lb.	.06½– .06½	.06½– .06½	.06 – .07½
Permanganate, drums	lb.	.14½– .15	.14½– .15	.13 – .13½
Prussiate, yellow, casks	lb.	.18¼– .18½	.18 – .18¼	.17 – .17½
Sal ammoniac, white, casks.	lb.	.06 – .07	.05½– .07	.06¼– .07½
Salsoda, bbl.	cwt.	1.10 – 1.30	1.20 – 1.40	1.20 – 1.40
Salt cake, bulk	ton	15.00 –18.00	15.00 –18.00	16.00 –17.00
Soda ash, light, 58%, bags, contract	cwt.	1.25 –.....	1.25 –.....	1.25 –.....
Dense, bags	cwt.	1.45 – 1.55	1.45 – 1.55	1.45 – 1.55
Soda, caustic, 76%, solid, drums, contract	cwt.	3.10 –.....	3.10 –.....	3.10 –.....
Acetate, works, bbl.	lb.	.04½– .05	.04½– .05	.04½– .05
Bicarbonate, bbl.	cwt.	2.00 – 2.25	2.00 – 2.25	1.75 – 2.00
Bichromate, casks	lb.	.06½– .06¾	.06½– .06¾	.07½– .07½
Bisculphate, bulk	ton	4.50 – 5.00	4.50 – 5.00	6.00 – 7.00
Bisulphite, bbl.	lb.	.03½– .04	.03½– .04	.04½– .04½
Chlorate, kegs	lb.	.06½– .06½	.06½– .06½	.06½– .07
Chloride, tech.	ton	12.00 –14.75	12.00– 14.75	12.00 –14.00
Cyanide, cases, dom.	lb.	.18 – .22	.18 – .22	.20 – .22
Fluoride, bbl.	lb.	.08½– .09	.08½– .09	.08½– .09
Hyposulphite, bbl.	lb.	.01½– .02½	.01½– .02½	.02 – .02½
Nitrate, bags	cwt.	2.50 –.....	2.47 –.....	2.50 –.....
Nitrate, casks	lb.	.08½– .09	.08½– .09	.09 – .09½
Phosphate, dibasic, bbl.	lb.	.03½– .03½	.03½– .03½	.03½– .03½
Prussiate, yel. drums	lb.	.10½– .10½	.10½– .10¾	.09½– .10
Silicate (30°, drums)	cwt.	.75 – 1.15	.75 – 1.15	.75 – 1.15
Sulphide, fused, 60-62%, dr.	lb.	.03 – .03½	.03 – .03½	.02½– .03
Sulphite, crys., bbl.	lb.	.03 – .03½	.02½– .03	.02½– .03
Strontium nitrate, bbl.	lb.	.08 – .08	.08 – .09	.09 – .09½
Sulphur, crude at mine, bulk	ton	15.00 –16.00	15.00 –16.00	14.00 –16.00
Chloride, dr	lb.	.04½– .05	.04½– .05	.04½– .05
Dioxide, cyl.	lb.	.09 – .10	.09 – .10	.08½– .09
Flour, bag	cwt.	15.35 – 3.00	2.35 – 3.00	2.25 – 2.35
Tin bichloride, bbl.	lb.	.16¼–.....	.16 –.....	.13¾–.....
Oxide, bbl.	lb.	.60 –.....	.62 –.....	.52 –.....
Crystals, bbl.	lb.	.41 –.....	.39½–.....	.35 –.....
Zinc chloride, gran., bbl.	lb.	.07½– .08	.07½– .08	.06 – .07½
Carbonate, bbl.	lb.	.10½– .11	.10½– .11	.12 – .14
Cyanide, dr.	lb.	.40 – .41	.40 – .41	.40 – .41
Dust, bbl.	lb.	.10 – .10½	.10 – .10½	.08 – .08½
Zinc oxide, lead free, bag.	lb.	0.07½–.....	0.07½–.....	0.07½–.....
5% lead sulphate, bags.	lb.	.07 –.....	.07 –.....	.06½–.....
Sulphate, bbl.	cwt.	3.00 – 3.50	3.00 – 3.50	3.00 – 3.25

Oils and Fats

		Current Price	Last Month	Last Year
Castor oil, No. 3, bbl.	lb.	$0.15½–$0.16	$0.16 –$0.16½	$0.16½–$0.17
Chinawood oil, bbl.	lb.	.13½– .14	.13½– .13¾	.15½– .16
Coconut oil, Ceylon, tanks, N. Y.	lb.	.11¼–.....	.11 –.....	.09½–.....
Corn oil crude, tanks, (f.o.b. mill)	lb.	.10 –.....	.09¾–.....	.09¾–.....
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.08¾–.....	.09 –.....	.09 –.....
Linseed oil, raw, car lots, bbl.	gal.	.99½–.....	1.05 –.....	1.00 –.....
Palm, Lagos, casks	lb.	.09¼–.....	.09 –.....	.08½– .08½
Niger, casks	lb.	.08¾–.....	.08¾–.....	.07¾–.....
Palm Kernel, bbl.	lb.	.11 – .11¼	.11 – .11¼	.10 –.....
Peanut oil, crude, tanks (mill)	lb.	.09¾–.....	.10¾–.....	.11¾–.....
Perilla, bbl.	lb.	.15½– .15¾	.15 – .15½	.14 – .14¼
Rapeseed oil, refined, bbl.	gal.	1.00 – 1.02	.97 – .98	.86 – .88
Sesame, bbl.	lb.	.15 – .15¼	.15 – .15½	.13½– .13¾
Soya bean tank (f.o.b. Coast)	lb.	.11¼–.....	.11½–.....	.10½–.....
Sulphur (olive foots), bbl.	lb.	.08¾–.....	.08 –.....	.09¼– .09½
Cod, Newfoundland, bbl	gal.	.62 – .64	.63 – .64	.63 – .65
Menhaden, light pressed, bbl.	gal.	.76 – .78	.78 – .80	.64 –.....
Crude, tanks (f.o.b. factory)	gal.	.50 –.....	.52½–.....	.50 –.....
Whale, crude, tanks	lb.	.07¼–.....	.07½–.....	.....–.....
Grease, yellow, loose	lb.	.09 – .09¼	.09¼– .09½	.07½–.....
Oleo stearine	lb.	.13¼–.....	.15 –.....	.13 –.....
Red oil, distilled, d.p. bbl.	lb.	.11¼– .11½	.11¼– .11½	.09½– .09½
Tallow, extra, loose	lb.	.10½ –	.09¼–.....	.08½–.....

Coal-Tar Products

		Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl.	lb.	$0.06 –$0.65	$0.60 –$0.65	$0.60 –$0.65
Refined, bbl	lb.	.90 – .95	.90 – .95	.65 – .75
Alpha-naphthylamine, bbl.	lb.	.35 – .36	.35 – .36	.35 – .36
Aniline oil, drums, extra	lb.	0.17 – 0.17½	0.17 – 0.17½	0.16 – 0.16½
Aniline salts, bbl	lb.	.20 – .22	.20 – .22	.22 – .23
Anthracene, 80%, drums	lb.	.60 – .65	.60 – .65	.70 – .75
Benzaldehyde, U.S.P., dr.	lb.	1.15 – 1.20	1.15 – .120	1.50 –.....
Benzidine base, bbl.	lb.	.75 – .77	.75 – .77	.80 – .82
Benzoic acid, U.S.P., kgs.	lb.	.60 – .62	.60 – .62	.75 – .85
Benzyl chloride, tech, dr.	lb.	.25 – .26	.30 – .31	.35 – .36
Benzol, 90%, tanks, works.	gal.	.24 – .29	.24 – .29	.23 – .28
Beta-naphthol, tech., drums	lb.	.22 – .24	.22 – .24	.24 – .25
Cresol, U.S.P., dr.	lb.	.18 – .20	.18 – .20	.23 – .25
Cresylic acid, 97%, dr., wks.	gal.	.59 – .63	.59 – .62	.63 – .65
Dichlorbenzene, dr.	lb.	.09 – .10	.09 – .10	.07 – .08
Diethylaniline, dr	lb.	.58 – .60	.55 – .57	.59 – .61
Dinitrophenol, bbl.	lb.	.30 – .33	.30 – .33	.35 – .38
Dinitrotoluen, bbl.	lb.	.16 – .18	.15 – .17	.18 – .20
Dip oil, 25% dr	gal.	.28 – .30	.28 – .30	.26 – .28
Diphenylamine, bbl.	lb.	.48 – .50	.48 – .50	.48 – .50
H-acid, bbl.	lb.	.72 – .73	.72 – .73	.72 – .73
Michelere Ketone, bbl.	lb.	3.00 – 3.20	3.00 – 3.20	3.00 – 3.20

Coal-Tar Products—Continued

	Current Price	Last Month	Last Year
Naphthalene, flake, bbl. lb.	$0.05 –$0.05½	$0.05 –$0.05½	$0.04½–$0.05
Naphthionic acid, crude, bbl.lb.	.55 – .58	.55 – .58	.60 – .62
Nitrobenzene, dr. lb.	.09½– .10	.09½– .10	.09 – .10
Ortho-amidophenol, kgs. lb.	2.15 – 2.20	2.15 – 2.20	2.40 – 2.50
Para-nitraniline, bbl. lb.	.58 – .60	.59 – .61	.68 – .70
Para-nitrotoluine, bbl. lb.	.35 – .36	.35 – .36	.50 – .55
Phenol, U.S.P., drums lb.	.22 – .24	.22 – .24	.24 – .26
Phthalic anhydride, bbl. lb.	.18 – .20	.19 – .21	.25 – .26
Picric acid, bbl. lb.	.25 – .26	.25 – .26	.20 – .22
Pyridine, dr. lb.	4.30 – 4.40	4.50 – 4.60	4.35 – 4.50
R-salt, bbl. lb.	.40 – .44	.40 – .44	.50 – .55
Resorcinal, tech, kegs. lb.	1.35 – 1.40	1.35 – 1.40	1.30 – 1.40
Salicylic acid, tech., bbl. lb.	.33 – .34	.33 – .34	.32 – .33
Solvent naphtha, w.w.,tanks.gal.	.26 –	.25 –	.25 –
Tolidine, bbl. lb.	.95 – .96	.95 – .96	1.00– 1.05
Toluene, tanks, works gal.	.26 –	.26 –	.26 –
Xylene, com., tanks gal.	.26 – .27	.26 – .27	.25 – .27

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl. ton	$20.00–$22.00	$17.00–$17.50	$16.00–$17.00
Casein, tech., bbl. lb.	.13½– .14	.13 – .13½	.10½– .11
China clay, powd., f.o.b. Ga.ton	10.00 –20.00	12.00 –15.00	14.00 –20.00
Imported, powd. ton	45.00 –50.00	45.00 –50.00	45.00 –50.00
Dry colors:			
Carbon gas, black (f.o.b. works) lb.	.07 – .07½	.07 – .07½	.09 – .11
Lamp black, bbl. lb.	.12 – .40	.12 – .40	.12 – .40
Prussian blue, bbl lb.	.34 – .36	.34 – .36	.36 – .38
Ultramine blue, bbl. lb.	.08 – .35	.08 – .35	.08 – .35
Sienna, Italian, bbl lb.	.04 – .12	.04 – .12	.05 – .12
Umber, Turkey, bbl. lb.	.04 – .06	.04 – .06	.04 – .06
Chrome green, bbl. lb.	.28 – .30	.28 – .30	.28 – .30
Carmine red, tins. lb.	4.90 – 4.75	4.50 – 4.75	4.50 – 4.70
Para toner. lb.	.90 – .95	.90 – .95	.95 – 1.00
Vermilion, English, bbl. lb.	1.35 – 1.50	1.40 – 1.45	1.30 – 1.35
Chrome yellow, C. P., bbl.lb.	.18 – .18½	.18 – .18½	.17 – .17½
Ocher, French, casks. lb.	.02½– .03½	.02 – .03	.02½– .03
Feldspar, No. 1 (f.o.b. N. C.)ton	5.50 – 5.00	5.50 – 6.00	6.50 – 7.00
Graphite, Ceylon, lump, bbl.lb.	.08½– .09	.08 – .09½	.05½– .06
Gum copal, Congo, bags. lb.	.08½– .10	.08½– .10	.09 – .14
East Indian, bags lb.	.14½– .15	.14 – .15	.16 – .18
Manila, bags. lb.	.14 – .16	.14 – .16	.18 – .19
Damar, Batavia, cases lb.	.25 – .26	.25 – .26	.23½– .24
Kauri, No. 1 cases. lb.	.57 – .65	.60 – .65	.60 – .65
Kieselguhr (f.o.b. N. Y.) ton	50.00 –55.00	50.00 –55.00	50.00 –55.00
Manganese, calc. ton	40.00 –41.00	35.00 –42.00	35.00 –40.00
Pumice stone, lump, bbl. lb.	.06 – .08	.04½– .08	.05 – .05½
Imported, casks. lb.	.03 – .40	.03 – .40	.03 – .35
Shellac, orange, fine, bags lb.	.52 – .53	.55 – .57	.63 – .64
Bleached, bonedry, bags. lb.	.59 – .62	.61 – .67	.71 – .72
T. N. bags. lb.	.49 – .51	.53 – .55	.59 – .60
Soapstone (f.o.b. Vt.), bags. ton	9.00 –11.00	7.00 – 7.50	7.50 – 8.00
Talc, 200 mesh (f.o.b. Vt.). ton	11.00 –	11.00 –	10.00 –
200 mesh (f.o.b. Ga.) ton	7.50 –10.00	7.50 –10.00	8.00 –12.00
325 mesh (f.o.b. N. Y.). ton	14.75 –	14.75 –	14.75 –
Wax, Bayberry, bbl. lb.	.20 – .21	.20 – .22	.21 – .21½
Beeswax, ref., light lb.	.40 – .42	.45 – .49	.32 – .34
Candelilla, bags lb.	.30 – .31	.30 – .31	.23 – .23½
Carnauba, No. 1, bags. lb.	.37 – .38	.37 – .38	.33 – .35
Paraffine, crude 105-110 m.p. lb	.06 – .06½	.06 – .06½	.06½–

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18% ton	$200.00–	$200.00–	$200.00–
Ferrochromium, 1-2% lb.	.23– .35	.23– .35	.30–
Ferromanganese, 78-82% ton	115.00–	115.00–	92.50–95.00
Spiegeleisen, 19-21% ton	32.00–33.00	31.00–32.00	33.00–35.00
Ferrosilicon, 10-12% ton	33.00–38.00	33.00–38.00	39.50–43.00
Ferrotungsten, 70-80% lb.	1.05– 1.12	1.15–	.88– .90
Ferro-uranium, 35-50% lb.	4.50–	4.50–	4.50–
Ferrovanadium, 30-40% lb.	3.25– 4.00	3.25– 4.00	3.25– 3.75

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic lb.	$0.14½–$0.14¾	$0.14½–$0.14¾	$.012½–$0.12¾
Aluminum, 96-99% lb.	.27 – .28	.28 –	.27 – .28
Antimony, Chin. and Jap. lb.	.17 – .17½	.16½– .17½	.11½– .11¾
Nickel, 99% lb.	.34 –	.33 – .34	.29 – .30
Monel metal, shot and blocks lb.	.32 – .33	.32 – .33	.32 – .33
Tin, 5-ton lots, Straits lb.	.60 –	.56½–	.49½–
Lead, New York, spot lb.	.09½–	.09½–	.08 –
E. St. Louis, spot. lb.	.09¼– .09½	.09½–	.07½–
Zinc, New York, spot lb.	.08¾– .08½	.08 –	.0655
E. St. Louis, spot. lb.	.08 – .08⅛	.07575–	.06½–
Silver, commercial. oz.	.70½–	.71½–	.72½–
Cadmium lb.	.60 –	.60 –	.60 –
Bismuth, 508-lb. lots lb.	2.65 – 2.70	2.65 – 2.70	1.85 – 1.90
Cobalt lb.	2.50 –	2.50 –	2.50 – 3.00
Magnesium, ingots, 99% lb.	1.00 –	1.00 –	.90 – .95
Platinum, ref. oz.	120.00–	120.00–	118.00–
Iridium oz.	400.00–	400.00–	400.00–
Palladium, ref. oz.	78.00– 83.00	78.00– 83.00	78.00–
Mercury, flask 75 lb.	80.50– 81.50	82.50– 83.00	71.00–
Tungsten powder lb.	1.20–	1.20–	.95– 1.00

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks. ton	$5.50– $5.50	$5.50– $8.50	$5.50– $8.75
Chrome ore, c.f. post ton	20.50– 23.50	20.50– 23.50	18.50– 24.00
Coke, fdry., f.o.b. ovens ton	3.75– 4.25	3.75– 4.25	4.00– 4.50
Fluorspar, gravel, f.o.b. Ill.ton	15.00– 18.00	16.00– 18.00	17.50– 18.50
Ilmenite, 52% TiO_2, Va. lb.	.01½–	.01½–	.01½–
Manganese ore, 50% Mn., c.i.f. Atlantic Ports unit	.42 – .44	.42 – .44	.41 – .45
Molybdemite, 85% MoS_2 per lb. MoS_2, N. Y. lb.	.65 – .70	.60 – .70	.70 – .75
Monazite, 6% of ThO_2 ton	120.00–	120.00–	120.00–
Pyrites, Span. fines, c.i.f. unit	.12½–	.12½–	.11½– .12
Furnace size unit	.13 –	.13 –	.12 –
Rutile, 94-96% TiO_2 lb.	.12 – .15	.12 – .15	.12 – .15
Tungsten, scheelite, 60% WO_3 and over unit	12.50 –13.00	12.50 –13.00	9.00 –
Vanadium ore, per lb. V_2O_5 lb.	1.00 – 1.25	1.00 – 1.05	1.00 – 1.25
Zircon, 99% lb.	.03 –	.03 –	.06 – .07

Current Industrial Developments

New Construction and Machinery Requirements

New England

Conn., Bridgeport — Remington Typewriter Co., Railroad Ave., awarded contract for the construction of a 3 story, 40 x 60 ft. ribbon and carbon paper factory to Stewart Engineering Co., 17 East 42nd St., New York, N. Y. Estimated cost $50,000.

Conn., Greenwich—Sewer Commissioners, H. E. Senft, Chn., will receive bids until Oct. 29 for the construction of sewage disposal works for Sewer Dist. 1, Sound Beach, including chlorine station, sludge drying beds, etc. Clyde Potts, 30 Church St., New York, N. Y., is consulting engineer.

Conn., Hartford — Hartford City Gas Light Co., 565 Main St., awarded contract for the construction of a steel container and an addition to gas purifier on Potter St., to Stacy Bros. Gas Construction Co., 5535 Carthage Pike, Elmwood, Cincinnati, O. Estimated cost $75,000.

Conn., Middletown — Wesleyan University, J. H. McConaughty, Pres., will soon award contract for the construction of a 3 story, 40 x 165 ft. laboratory. Estimated cost $30,000. McKim, Meade & White, 101 Park Ave., New York, N. Y., are architects.

Conn., Milford—The New Haven Laboratories, Inc., T. F. Flaacke, Pres., has acquired property on the Milford turnpike and plans the construction of a 2 story, 50 x 100 ft. plant for the manufacture of drugs and chemicals.

Conn., Naugatuck—Rubber Regenerating Co., Elm St., awarded contract for the construction of a 3 story factory to Berlin Construction Co., Depot Road. Estimated cost $25,000.

R. I., Providence—W. H. Coe Mfg. Co., 74 Weybosset St., is receiving bids for the construction of a 2 story factory for the manufacture of gold leaf, gilding wheels, etc., at Clifford and Ship Sts. Estimated cost $40,000. Perry & Whipple, Hospital Trust Bldg., are architects.

Middle Atlantic

Md., Brooklyn (Baltimore P. O.)—General Refractories Co., 7th and Chesapeake Sts., plans the construction of a 2 story, 40 x 55 ft. factory. Estimated cost $20,000.

N. J., Lambertville — Poquonock Bag & Paper Co., G. A. Leavitt, Pres., has purchased the plant of Jesperson Newsprint Co., and plans to expend $100,000 for improvements including installation of new paper making machinery. Architect not selected.

N. Y., Beacon—The Tucker Rubber Corporation, 32 Spencer St., Buffalo, is in the market for machinery and equipment for plant for the manufacture of rubber goods here.

N. Y., Buffalo — Dupont Fibersilk Co., River Road, awarded contract for the construction of addition to plant for manufacture of rayon to Dupont Engineering Co., Dupont Bldg., Wilmington, Del. $8,000,000.

N. Y., Buffalo—The Muffets Corporation, Batavia, plans the construction of a breakfast cereal factory here. Estimated cost $1,000,000.

N. Y., New York—Consolidated Gas Co., 130 East 15th St., awarded contract for the construction of a gas plant on Hunts Point Road to William F. Kenny Co., 44 East 23rd St. Estimated cost $4,000,000.

Pa., Duquesne—Carnegie Steel Co., Carnegie Bldg., Pittsburgh, is receiving bids for the construction of a 1 story, 50 x 56 ft. water purification plant. W. B. Scaife & Sons Co., Oakmont, is engineer.

Pa., Hillsville—Lake Erie Limestone Co., Wick Bldg., Youngstown, O., will build by separate contracts a 1 story, 35 x 60 ft. crushing and loading plant here. Allis-Chalmers Co., West Allis, Wis., is engineer.

Pa., Kittanning—Kittanning Plate Glass Co., 509 Peoples Bank Bldg., Pittsburgh, is having plans prepared for the construction of a 1 story glass plant here. Estimated cost $2,000,000. H. L. Dixon Co., Carnegie, is engineer.

Pa., Latrobe — Latrobe Electric Steel Co. awarded contract for the construction of a 60 x 400 ft. addition to plant to Fort Pitt Bridge Works, Oliver Bldg., Pittsburgh.

Pa., New Brighton—Standard Sanitary Mfg. Co., Bessemer Bldg., Pittsburgh, will soon award contract for the construction of a 4 story, 50 x 98 ft. addition to plant here. B. H. Prack, Martin Bldg., Pittsburgh, is architect.

Pa., Salina—Kier Fire Brick Co., 1844 Oliver Bldg., Pittsburgh, awarded contract for the construction of a 1 story brick plant here to H. K. Ferguson Co., 6300 Euclid Ave. Estimated cost $100,000.

South

Ala., Demopolis—Warrior Cement Corporation, 705 Battle Place, Chattanooga, Tenn., awarded contract for the construction of six storage silos, 110,000 bbl. capacity and packing plants here, to Bland Engineering Co., North East L. and Kennedy Sts., Minneapolis, Minn.

Ala., Eufaula—Foy & Vance, c/o S. A. Foy, Pres., has had plans prepared for the construction of a peanut mill to increase capacity to 100,000 lb. daily.

Fla., Clewiston—Celotex Co., B. D. Dahlberg, Pres., 645 North Michigan Ave., Chicago, Ill, plans the construction of a 3 unit plant for the manufacture of sugar here. Smith & Ames, 15 William St., New York, N. Y., are engineers.

Fla., Fort Pierce — C. E. Cahow, Mayor and Bd. of City Comrs., will receive bids until Oct. 28 for the construction of a water softening and purification plant. American Industrial Engineering Co., 140 Cedar St., New York, N. Y., is engineer and The Bishop Engineering Co., 116 South Orange Ave., Orlando, associate engineer.

La., Elizabeth — The Calcasieu Sulphate Paper Co., R. M. Hallowell, Pres., recently incorporated, capital $1,750,000 has acquired the mill of the Calcasieu Mfg. Co., and plans to remodel for new plant. Additional equipment will be required.

La., New Orleans—H. L. Sullivan, 915 Whitney Central Bldg., wants price data, etc., on kaolin machinery equipment; also washing processes.

Miss., Meridian — American Creosote Works, S. C. Braselman, Gen. Mgr., Southport, New Orleans, La., is having preliminary plans prepared for the construction of a creosoting plant, 50,000,000 ft. annual capacity. Private plans.

Miss., Natchez — Southern Railway & Light Co., is having plans prepared for rebuilding gas plant including installation of purifiers, tar extractors, condensers, scrubbers, etc., to increase capacity. Estimated cost $85,000.

N. C., Charlotte—Lockwood Greene & Co., Piedmont Bldg., is preparing tentative plans for the construction of a new plant for the manufacture of sodium sulphate, acetic acid, etc., here, for Grasselli Chemical Co., Birmingham, Ala. Estimated cost $150,000 to $200,000.

Tenn., Chattanooga—Chattanooga Stamping & Enameling Co., is having plans prepared for the construction of a 1 and 2 story, 50 x 100 and 30 x 60 ft. metal working plant. Estimated cost $50,000. E. P. Poste, c/o owner, is chief engineer.

W. Va., Clarksburg — National Carbon Co., 30 East 42nd St., New York, N. Y., has completed plans for extension to plant including installation of a furnace, overhead crane, etc. Estimated cost $150,000. Private plans.

Middle West

Ill., Chicago — Plibrico Jointless Fire Brick Co., Kingsbury St., awarded contract for the construction of a 2 story, 76 x 131 ft. factory for manufacture of monolithic fire brick, to E. W. Sproul & Co., 2001 West Pershing Road. Estimated cost $200,000.

Ill., Chicago—Waterway Paper Products Co., 3201-3209 South Kedzie Ave., awarded contract for the construction of a 2 story factory for the manufacture of newsprint and wall paper out of old paper, to Schmidt Bros. Construction Co., 22 East Huron St. Estimated cost $78,000.

Ill., Hartford—International Shoe Co., 15th St. and Washington Ave., St. Louis, is having preliminary plans prepared for the construction of a 2 story, 118 x 160 ft. tannery. Estimated cost $100,000. Private plans.

Ill., Woodriver—Standard Oil Co., of Indiana, C. B. Manbeck, Gen. Mgr., will soon receive bids for the construction of addition to oil refinery. Will replace 60 high pressure stills with six units of Holmes-Manley pressure pipe stills, also construct addition to paraffin factory. Estimated cost $1,250,000. Private plans.

Ind., Kokomo — The Kokomo Brass Co. awarded general contract for the construction of a 1 story, 50 x 132 ft. addition to plant to E. L. Danner. Estimated cost $37,000.

Ind., Limedale — Indiana Portland Cement Co., 729 State Life Bldg., Indianapolis, subsidiary of International Cement Corp., 342 Madison Ave., New York, N. Y., awarded contract for the construction of 2 story, 50 x 100 ft. addition, including laboratory, here, to State Constr. Co., 726 Indiana Pythian Bldg., Indianapolis, Ind. Estimated cost $70,000.

Ind., Muncie—Hemingray Glass Co., F. J. Lesh, Auditor, 8th St. and Macedonia Ave., has had plans prepared for the construction of a 1 story, 60 x 250 ft. factory and storage building. Estimated cost $40,000.

Mich., Holland — Sewage Comn., C. Kirchen, Chn., will receive bids until Oct. 21st for the construction of a sewage treatment plant including pumping station, sedimentation tank, glass covered sludge beds, electrically driven centrifugal pumps, chlorinating apparauts, etc.

Mich., Sturgis — The Morency-Van Buren Mfg. Co., A. F. Morency, awarded contract for the construction of a 1 story, 50 x 75 ft. addition to brass foundry. Estimated cost $32,000.

O., Alliance—Stewart Bros. Paint Co. will soon receive bids for the construction of a paint factory at North Union Ave.

O., East Liverpool—Board of Education, C. S. McVay, is in the market for clay making machinery and equipment for ceramic course in high school. Estimated cost $5,000.

O., Findlay—Giant Tire & Rubber Co., C. E. Hart, plans the construction of a 2 story, 80 x 200 ft. factory addition for the manufacture of rubber tires. Estimated cost $50,000. Owner is in the market for complete equipment for the addition.

O., Mansfield — The Mansfield Vitreous Enameling Co., L. A. Adams, Mgr., awarded contract for the construction of an 80 x 140 ft. addition to plant to Jacob Wolf Co. Estimated cost $22,000.

O., Zanesville — Pittsburgh Plate Glass Co., F. A. Jones, Local Mgr., plans addition to factory including 2 additional kilns, etc., at White Cottage. Estimated cost $100,000. Owner is also in the market for grinding machinery and equipment for cement making plant.

Wis., Browntown — Merrell-Soule Co. will build a 1 and 2 story powdered milk factory by day labor. Estimated cost $150,000. Private plans. Machinery will be required.

Wis., Sparta—Pet Milk Co., will build a 3 story, 67 x 180 and 60 x 80 ft. addition to condensory by day labor. Estimated cost $50,000. Private plans.

Wis., Two Rivers—Wisconsin Public Service Corporation, 559 Marshall St., Milwaukee, will build a gas plant, work to be done by day labor. Estimated cost $200,000. A. F. Davey, c/o owner, is architect.

West of Mississippi

Colo., Denver—Gates Rubber Co., 999 South Broadway, C. C. Gates, Pres., has had plans prepared for 2 story, 50 x 125 ft. addition to tire and tube works, here. Estimated cost $100,000. Also plans additional unit, to cost $150,000. Machinery will be required.

Mo., St. Louis — Dr. J. H. McLean Medicine Co., 3120 Franklin Ave., awarded contract for the construction of a 2 story, 35 x 135 ft. addition to plant to Chapline Construction Co., Wainwright Bldg. Estimated cost $50,000.

Mo., Savannah—City plans an election Oct. 20th to vote $70,000 bonds for improvements to waterworks including a purification plant, etc. J. W. Shikles & Co., 708 New York Life Bldg., Kansas City, are engineers.

Tex., Edinburg—The Farmers Canning Co., J. W. Smith and G. W. Walton, recently incorporated, plans the construction of a 1 and 2 story canning plant. Estimated cost $50,000. Machinery will be required.

Tex., Edinburg—Rio Grande Valley Canning Co., J. W. Smith, V. Pres., is having plans prepared for the construction of a canning plant. Estimated cost $40,000. Private plans. Canning machinery will be installed.

Tex., El Paso—Globe El Paso Cotton Oil Co. is having plans prepared for the construction of a 1 story, 280 x 390 ft. cotton seed storage building. Estimated cost $160,000. Private plans.

Tex., Houston—Magolis Gas Products Co., subsidiary of South Texas Cotton Oil Co., plans the construction of a plant for the manufacture of acetylene gas. Machinery will be required. Estimated cost $500,000.

Tex., San Antonio—Victor Von Schoeler Sr. & Sons, New Orleans, La., plans the construction of a dehydrating plant here. Estimated cost $25,000. Private plans. Machinery will be installed.

Tex., Slaton—Atchison, Topeka & Santa Fe Ry., Topeka, plans the construction of a water treating plant. Estimated cost $40,000. H. W. Wagner, 1417 Topeka St., Topeka, is chief engineer. Equipment will be purchased.

Far West

Calif., Oroville — Wyandotte Canneries, Inc., awarded contract for the construction of a new vatroom and warehouse to increase capacity of plant near here, to A. A. Plaage. Estimated cost $22,000.

Calif., Richmond — California Art Tile Co., J. W. Hislop, Pres., plans improvements to tile plant including kilns, etc., at 27th St. and Main Ave. Estimated cost $30,000.

Wash., Monse — Sodium Products Co., H. H. Underhill, Gen. Mgr., Oroville, plans the construction of an evaporating and cleaning plant with a capacity of 500 tons of sodium sulphate daily.

Canada

B. C., New Westminster—G. A. Touche Ltd., London, Great Britain, will soon receive bids for the construction of a 220 x 396 ft. paper mill here. Estimated cost $2,000,000.

Ont., Perth—Lanark Lime Co. Ltd., C. A. Smart, 638 Belgium Ave., Westmount, Que., is in the market for complete machinery for reducing limestone and preparing hydrated lime; also quarry equipment.

Que., Cap Rouge—St. Regis Paper Co., Ltd., 11 Place d'Armes, Montreal, is in the market for complete equipment for new pulp and paper mill here.

Que., Limolou—Anglo-Canadian Pulp & Paper Mill Co., c/o Gulf Pulp & Paper Co., 71 St. Peter St., Quebec, is having preliminary plans prepared for the construction of a paper mill here. Estimated cost $15,000,000. G. F. Hardy, 309 Broadway, New York, N. Y., is engineer.

Que., Port Alfred—Port Alfred Pulp & Paper Corporation, G. McKee, Pres., awarded general contract for the construction of a newsprint plant, 200 tons daily capacity, to The Foundation Co., 746 Sherbrook St. West, Montreal. Estimated cost $3,500,000.

Incorporations

Skenandoa Rayon Corporation, Dover, Del., manufacture, $63,500,000, (635,000 shares, no par, of which 25,000 shall be first of common stock). R. K. Ferguson, H. S. Sutton, W. C. Hull, Jr., Bronxville, N. Y. (Corporation Trust Co. of America, Dover, Del.)

Eastern Oil Processing Co., Dover, Del., oil, $700,000. (J. M. Satterfield, Dover, Del.)

International Rubber Co., Wilmington, Del., $30,000,000, 300,000 shares, no par. (Corporation Service Co.)

Cotton States Fertilizer Co., Popler St., Macon, Ga., $300,000 to $400,000.

International Pyorrhea Co., Chicago, Ill., tooth powder, $5,000,000. E. A. Ernest, G. W. Buettner, P. A. Buettner. (Corporation Guarantee Trust Co.)

Cape Cod Oil Co., Hyannis, Mass., crude and refined oils, 1,000 no par value shares. E. W. Gould, West New Brighton, Staten Island, N. Y., F. H. S. Hyde, Hyannis, Mass., D. B. Newell, Brookline, Mass., P. M. Swift, Barnstable, Mass.

Eastern Seaboard Power Corporation, Bay Shore, N. Y., manufacture coke, coal, coal tar, gas and electric fixtures, $15,000,000. H. H. Frost, J. W. Little, E. B. Sanford, 50 Church St., New York, N. Y.

Adirondack Feldspar Corporation, Albany, N. Y., $300,000. R. C. Poskanzen, J. Ilich, N. M. Medwin. (Attys., Muhlfelder & Ilich, Albany, N. Y.)

Arctic Refining Co., Parnassus, Pa., $50,000, manufacturing, refining and compounding gasoline, etc. D. A. Hankey, L. J. Robertson, Parnassus, B. H. Thompson, New Kingston, Pa.

Pennsylvania Natural Gas & Refractory Co., Philadelphia, Pa., $3,000,000. (Corporation Guarantee & Trust Co.)

Northern Ontario Pulp & Paper Co., Ltd., Montreal, Que., $5,000,000.